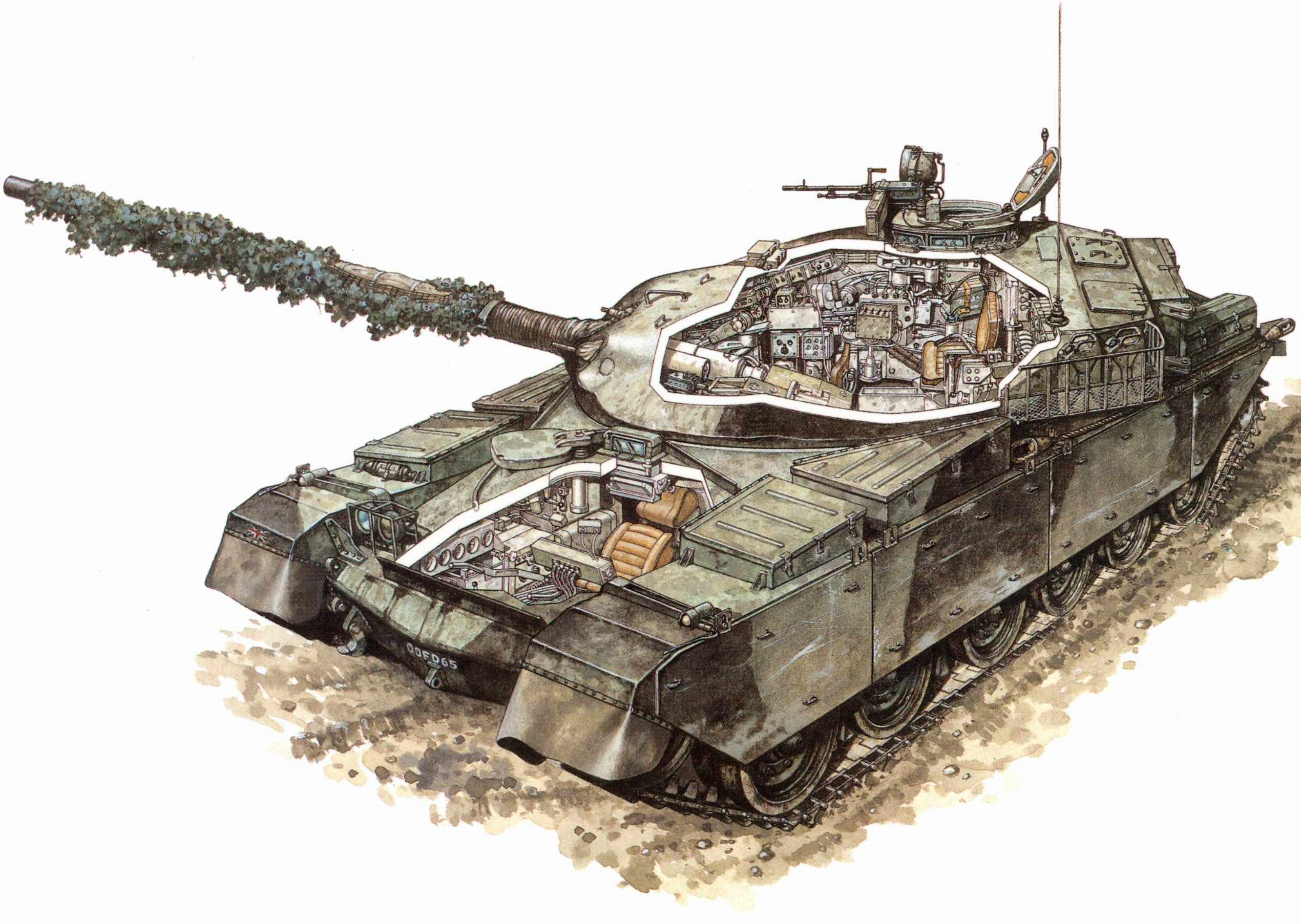
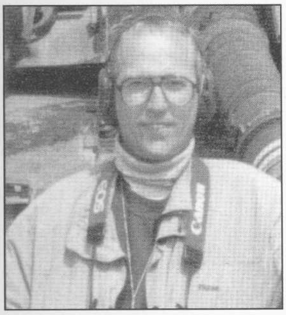
New Vanguard

OSPREY
PUBLISHING

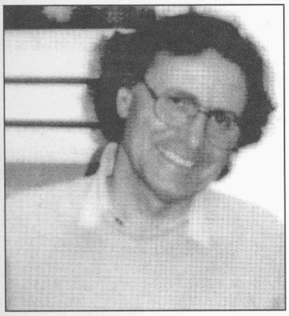
Chieftain Main Battle Tank 1965–2003



Simon Dunstan • Illustrated by Peter Sarson



SIMON DUNSTAN is a well-established author, film maker and photographer in the field of military history, with several titles already published by Osprey. He specialises on the subject of armoured warfare, a field about which he has been writing for two decades. His books have covered topics such as helicopter and armoured warfare in Vietnam, the Challenger MBT, The British Guards and armoured warfare in Korea. Simon lives and works in London.



PETER SARSON has produced graphic cutaways for many armoured vehicle publications, and is regarded as one of the world's great illustrators of military vehicles. Peter lives and works in Dorset, UK.

CONTENTS

BIBLIOGRAPHY 2

DEVELOPMENT HISTORY 3

DESIGN AND DEVELOPMENT 4

TECHNICAL DESCRIPTION OF THE CHIEFTAIN MARK 5 15

CHIEFTAIN VEHICLES AND VARIANTS 19
- FV4201 prototypes
- Mark 1
- Mark 2
- Mark 3
- Mark 4
- Mark 5 and Mark 5/P
- Mark 6
- Mark 7
- Mark 8
- Mark 9
- Mark 10
- Mark 11
- Mark 15
- FV4202
- FV4203 AVRE
- FV4204 ARV
- FV4205 AVLB
- The development of the L60 engine
- Totem Pole

CHIEFTAIN SPECIAL PURPOSE VARIANTS 37
- FV4204 Chieftain Armoured Recovery Vehicle
- FV4205 Chieftain Armoured Vehicle Launched Bridge (AVLB)
- Chieftain Armoured Vehicle Royal Engineers (CHAVRE)

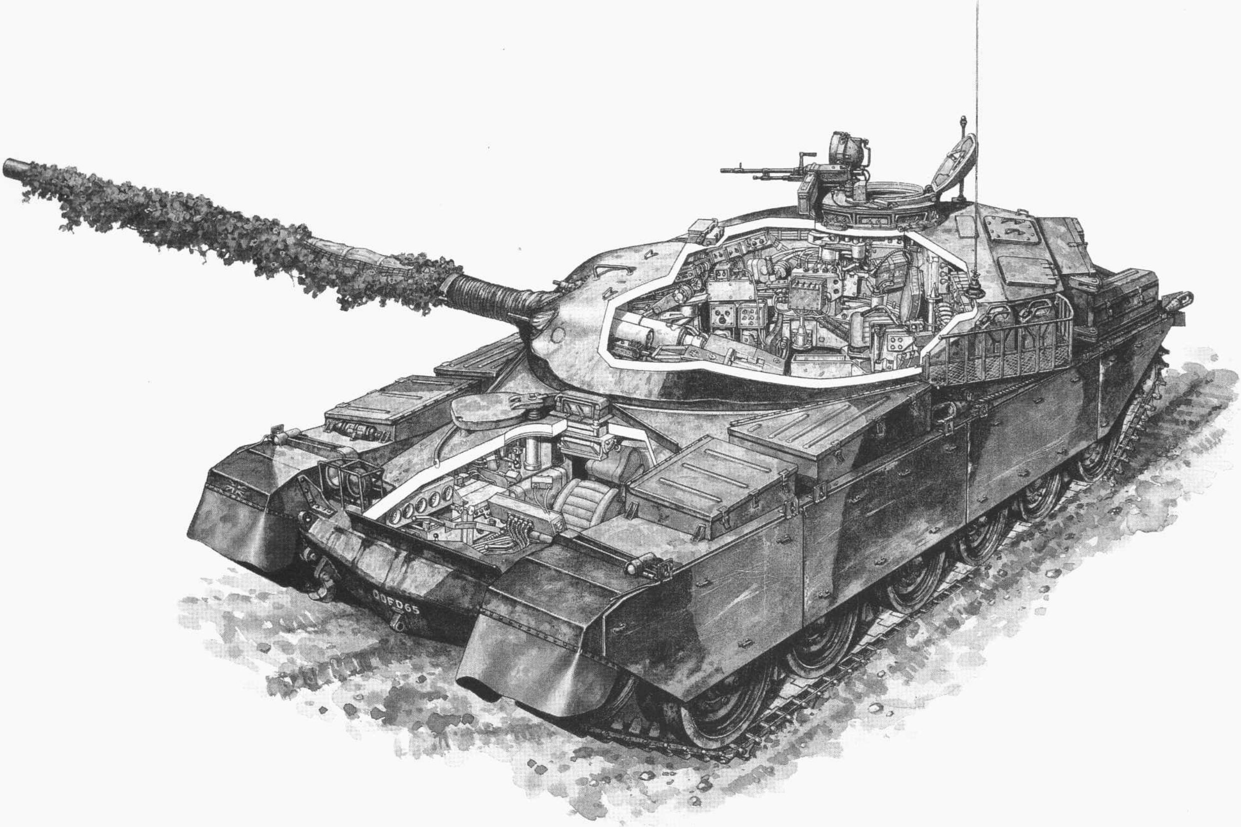
COLOUR PLATE COMMENTARY 44

INDEX 48

New Vanguard • 80

OSPREY
PUBLISHING

Chieftain Main Battle Tank 1965–2003



Simon Dunstan • Illustrated by Peter Sarson

First published in Great Britain in 2003 by Osprey Publishing, Elms Court,
Chapel Way, Botley, Oxford OX2 9LP, United Kingdom.
Email: info@ospreypublishing.com

© 2003 Osprey Publishing Ltd.

All rights reserved. Apart from any fair dealing for the purpose of private study, research, criticism or review, as permitted under the Copyright, Designs and Patents Act, 1988, no part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, electrical, chemical, mechanical, optical, photocopying, recording or otherwise, without the prior written permission of the copyright owner. Enquiries should be addressed to the Publishers.

ISBN 1 84176 719 0

Editor: Simone Drinkwater
Design: Melissa Orrom Swan
Index by Alison Worthington
Originated by Electronic Page Company, Cwmbran, UK
Printed in China through World Print Ltd.

03 04 05 06 10 9 8 7 6 5 4 3 2 1

FOR A CATALOGUE OF ALL BOOKS PUBLISHED BY OSPREY MILITARY AND AVIATION PLEASE CONTACT:

Osprey Direct UK, P.O. Box 140, Wellingborough, Northants, NN8 2FA, UK
E-mail: info@ospreydirect.co.uk

Osprey Direct USA, c/o MBI Publishing, P.O. Box 1, 729 Prospect Ave, Osceola, WI 54020, USA
E-mail: info@ospreydirectusa.com

www.ospreypublishing.com

BIBLIOGRAPHY

Fighting Vehicles, RMCS Shrivenham, Brasseys, London, 1991
The Chieftain Tank, Simon Dunstan, Arms and Armour Press, 1989
Chieftain, George Forty, Ian Allan Publishing, 1979
Chieftain, Rob Griffin, The Crowood Press, 2001
Modern Battle Tanks, Michael Norman, Profile, 1978
The archives of The Tank Museum, Bovington, Dorset, UK.
The archives of Mike Verrall.

Author's dedication

To George Forty OBE FMA, who as an author and Curator of The Tank Museum has done so much to broaden the appeal and understanding of the extraordinary world of Armoured Fighting Vehicles.

Author's acknowledgements

The Craftsman, David Fletcher, George Forty, Christopher F Foss, Oleg Granovsky, Dennis Lunn, Mike Norman, Ken Pavitt, Royal Engineers Journal, REME Journal, Royal Ordnance Factories, Soldier Magazine, Mike Verrall, Vickers Defence Systems.

Artist's note

Readers may care to note that the original paintings from which the colour plates in this book were prepared are available for private sale. All reproduction copyright whatsoever is retained by the Publishers. All enquiries should be addressed to:

Peter Sarson, 46 Robert Louis Stevenson Avenue, Westbourne, Bournemouth,
BH4 8EJ, UK

The Publishers regret that they can enter into no correspondence upon this matter.

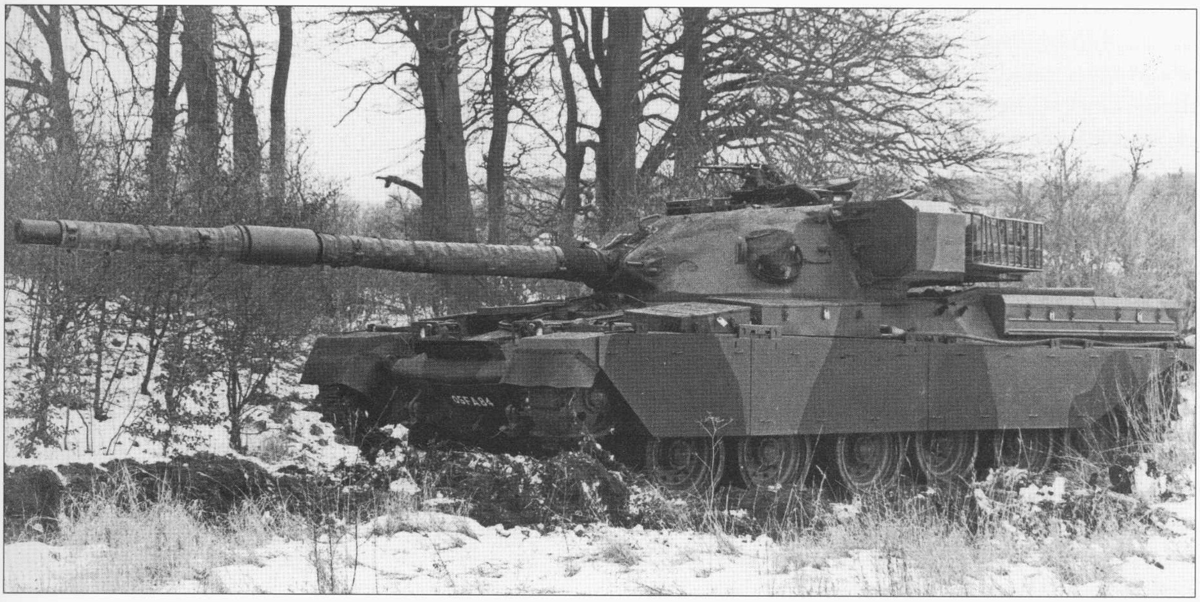
CHIEFTAIN MAIN BATTLE TANK 1965–2003

DEVELOPMENT HISTORY

Although the British invented the tank and used it to telling effect in the final offensives of the Great War, further development withered on the vine in the years of post-war austerity and the conflicting demands of policing a worldwide empire. It was the defeated Germans who saw the full potential of the tank and, with the rise to power of Adolf Hitler, the concept of Blitzkrieg was nurtured with devastating consequences. In the early years of World War II, the Panzers of the triumphant Wehrmacht swept all before them. Throughout the war, British tank designs lagged behind their German counterparts in terms of firepower and armour protection. Moreover, most suffered from chronic mechanical unreliability. The situation was exacerbated by having different classes of tanks for infantry support and offensive operations, which squandered scant resources and militated against a coherent armoured doctrine. By 1944 Field Marshal Montgomery and others were advocating the concept of a Universal Tank to replace the discredited Infantry and Cruiser classes of tanks, but this idea was not pursued until after the war had ended.

The design of the so-called Universal Tank began in 1946 under the designation A45 just as the final example of the Cruiser class of tanks, the Centurion, was entering service with the British Army (see New Vanguard 68: *Centurion Universal Tank 1943–2003*). However, development of the A45 was slow and the Universal concept was severely compromised when

The Chieftain was Britain's first true Main Battle Tank or MBT. It superseded both of the former classes of tanks represented by the Centurion Medium Tank and the Conqueror Heavy Tank which were a legacy of the World War II policy of having two distinct types of tanks, designated Cruiser and Infantry, for different kinds of armoured operation. With its powerful 120mm main armament and well-sloped, heavy armour, the Chieftain was the most formidable MBT in the NATO alliance for many years.

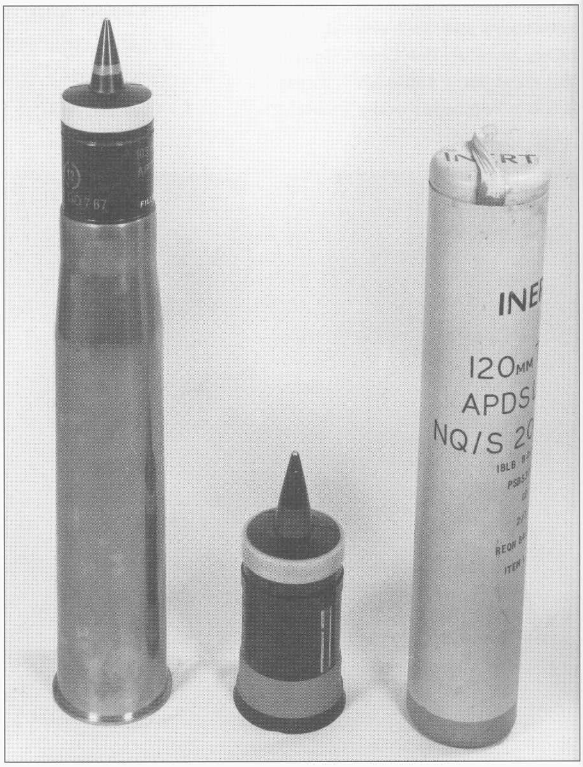


it proved too difficult to modify the design for special-purpose tasks such as amphibious assault or minesweeping. The A45 was abandoned in 1948 in favour of further development of the Centurion. Ironically, the latter was able to be adapted to most of the roles envisaged for the Universal concept and it proved to be the outstanding tank of its generation. Yet, the Universal concept is specific and it was not to be realised for some years until the emergence of the first true Main Battle Tank (MBT) for the British Army – the Chieftain.

DESIGN AND DEVELOPMENT

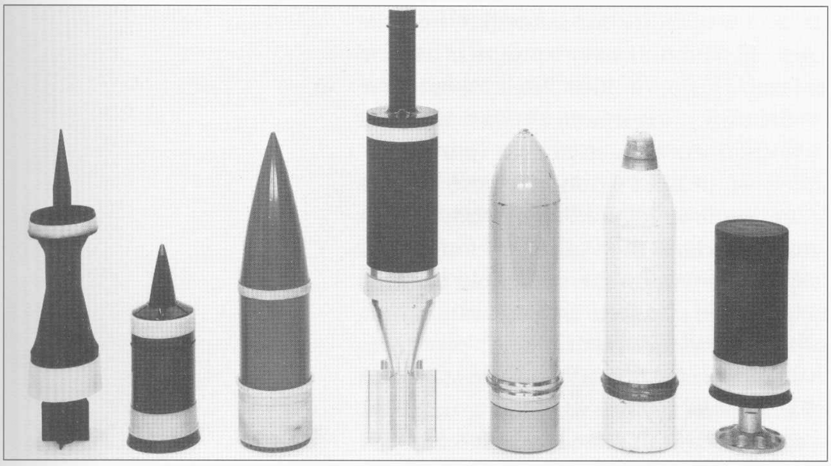
The development of a successor to the Centurion began in 1951 under the designation Medium Gun Tank No. 2. Following the turmoil of tank development during World War II, the designers were given free rein to explore new technologies without the constant demands of the Army to field the latest untested models to counter the superior German Panzers that had exacted such a fearful toll of Allied tanks from North Africa to Northwest Europe. The threat was now posed by the massed armoured forces of the Soviet Union and its Warsaw Pact client states. The Soviet bloc was equipped with thousands of effective medium tanks such as the T-34/85 supported by hundreds of heavy tanks including the IS-3 with its powerful 122mm main armament. To counter such numbers, the Western Allies pursued a strategy of quality over quantity, but in the early 1950s the only NATO countries manufacturing tanks in any numbers were Britain and the USA. Accordingly, the two nations co-operated in many facets of tank design including a desire for a standard main armament. To this end, priority for the Medium Gun Tank No. 2 was given to firepower over armour protection or mobility. Mobility was not neglected, however. It had to be at least as good as for the Centurion, with the emphasis on battlefield agility rather than a high top speed. The gun/armour combination would be determined by the overall weight of the vehicle, which the General Staff required to be less than 45 tons. Radical innovations would be needed to meet such a weight limit and these were addressed in a wide-ranging research process known as the Concept Study Programme.

A fundamental design feature of the Chieftain was the use of two-piece ammunition for more efficient stowage and ease of handling inside the fighting compartment. On the left is a 105mm Armour Piercing Discarding Sabot (APDS) round of the world famous L7 tank gun as compared to the 120mm APDS projectile and its associated combustible cased propellant charge. The Combustible Cartridge Case is much lighter than a conventional brass case and so much weight is saved overall.



At the outset, the US T-104 105mm gun firing HVAP, AP and HEAT rounds was proposed together with a 100-in. turret ring to allow a well-sloped glacis plate for greater armour protection over the frontal aspect. However, the T-104 was a massive weapon and the handling and stowage of its ammunition within the fighting compartment posed insurmountable problems when using normal one-piece rounds with brass shell casings. The solution was to provide an automatic loader but this was deemed to be overly complex and unreliable and allowed space for only 40 rounds to be stowed under armour.

In 1953, after consultation between the weapons designers at the Armament Research and Devel-



The L11 series 120mm rifled tank gun was capable of firing a variety of projectiles as illustrated with from left to right: L23A1 APFSDS-T (Armour Piercing Fin Stabilised Discarding Sabot Tracer); L15A4 APDS-T (Armour Piercing Discarding Sabot Tracer); L31 HESH (High Explosive Squash Head); HEAT (High Explosive Anti-Tank) for foreign sales; L34 Smoke; Illuminating and Canister – this last being a fiendish anti-personnel round. In addition, there were practice rounds for gunnery training.

opment Establishment (ARDE) at Fort Halstead and the tank designers at the Fighting Vehicles Research and Development Establishment (FVRDE) at Chertsey in Surrey, it was decided to investigate the feasibility of liquid propellant guns. This technology offered several significant theoretical advantages, including simpler ammunition handling, as the loader had only to manhandle the projectile and not the shell casing, and a marked increase in muzzle velocity: the higher the muzzle velocity, the greater the armour penetration. The project demanded a considerable amount of development and testing of guninstallations with the complex feed system for the volatile liquidpropellant, but the design team was minuscule with inadequate resources and the concept came to naught, primarily because the liquid propellant reservoir grew to overly large proportions in order to withstand the necessary pressures for the system to function.

Nevertheless, much useful data was accumulated which benefited other projects that were being pursued simultaneously. One of the most promising was the bagged charge concept, which had been successfully used by the world's navies for many years. Its application in a tank was novel and presented several advantages over fixed one-piece ammunition. The main benefits were easier handling within the fighting compartment for the loader and increased stowage space to allow more rounds to be carried. The weight of the metal cases was saved and no provision had to be made to collect the spent cases inside the turret for subsequent disposal. In addition, the hazard of noxious fumes from the spent cases was eliminated. In essence, the loader rammed a projectile, be it AP or HE, into the breech followed by the bagged propellant charge. A vent tube primer then ignited the charge, which was totally consumed in the subsequent explosion. Trials demonstrated that the use of two-piece ammunition did not markedly reduce the rate of fire from the desired six rounds a minute. There were however severe reservations concerning the risk of catastrophic ammunition fires if the bagged charges in their stowage bins were penetrated by red hot fragments – the most dreaded hazard for tank crewmen.

Ammunition fires had been the cause of many fatalities during World War II, particularly in tanks that stowed their ammunition in the turret. As the highest part of the tank, the turret was most likely to be hit by direct fire weapons and, if penetrated, any rounds stowed inside were likely to be ignited, with dire consequences for the crew. Many Allied tank designs suffered from this fault but the M4 Sherman was more prone than most to ammunition fires, particularly the petrol-engined variants used by the British. It was a lesson they took to heart and the design of the Centurion ensured that all main armament rounds were stowed below the level of the turret ring, where they were less likely to be ignited if the turret was penetrated.

This method was continued in the Centurion's successor but, because of the bagged charge concept, more efficient and safer stowage of ammunition was possible. To allay the fears of ammunition fires further, the bagged charges were stowed below the turret ring in water jackets which, if penetrated by red hot fragments, doused the bagged charge in a water/glycol mixture that either precluded or delayed ignition of the cordite charges.[1] The nature of two-piece ammunition allowed AP rounds (which have no explosive content) to be stowed around the walls of the turret and in outside stowage bins for rapid replenishment on the battlefield while all propellant charges and HE projectiles were stowed in the hull. Consequently, although the use of two-piece ammunition has been proven to enhance crew safety, its main advantage was more efficient stowage and therefore more rounds carried for a given calibre of main armament. Despite the much larger calibre, the Chieftain Mark 5 was able to carry 64 120mm rounds as against 65 20-pdr. (83.4mm) of the Centurion Mark 5.

The development of the bagged charge concept with a gun of 105mm calibre began in 1954. At this time, the Study Concept Programme was investigating numerous innovative design avenues: including AFVs armed with guided missiles or a combination weapon firing free flight rockets and a low velocity gun (later to come to fruition in the form of the 152mm Shillelagh weapon system of the M-551 Sheridan); a fixed gun vehicle with a variable suspension (later to see fruition as the Swedish Strv. 103 S-Tank); a tank with an oscillating turret and automatic loading system (later to see fruition as the French AMX-13); coupled vehicles with the automotive train in the front section and the fighting compartment in the rear (later to see fruition as the All-Terrain Vehicle Bandvagn Bv. 206) and small air-portable one- and two-man tanks. One such design was the FV4401 Project Prodigal armed with externally mounted twin 120mm recoilless rifles fed by rotary magazines each holding seven rounds of HESH ammunition. The General Staff was much concerned during the 1950s with the concept of strategic air-portability to move troops and equipment by aircraft to meet the commitments of a far-flung empire embroiled in minor wars and insurrections. In the event, Project Prodigal never saw the light of day but the idea later emerged in the guise of the CVR(T) – Combat Vehicle Reconnaissance (Tracked) – family of air-portable AFVs such as the Scorpion, Scimitar, Striker, Spartan, Samson and Samaritan.

Notwithstanding this requirement for air-portability, in 1954 the General Staff reiterated its belief in a conventional four-man tank with a fully rotating turret, but with a greater gun/armour combination than that of the Centurion to counter the preponderance of Soviet heavy tanks massed along the Inner German Border. This requirement was concurrently being addressed by the development of the FV214 Conqueror Heavy Tank, which was the last vestige of the Universal Tank programme that had been initiated in 1946. The Conqueror was scheduled to enter service in 1956, but only in limited numbers, with manufacture to cease in 1957 after the production of some 200 models. Its purpose was to bolster the Centurion armoured regiments with long-range firepower thanks to its US designed 120mm main armament and sophisticated fire control system. The Centurion was still armed with the 20-pdr. gun. By now, it was provided with highly effective APDS ammunition, but even so the tank was likely to become obsolete before long.

---

[1] Many an Iranian tank crewman has cause to be grateful for this system. Despite their heavy armour, many Chieftains fell victim to Iraqi weapons during the protracted Iran–Iraq War of the 1980s but frequently, once penetrated, the tell-tale fizzing and white smoke being emitted from a bagged charge water container gave the crew sufficient time to evacuate the vehicle before combustion began. The delay was often as long as a matter of minutes which allowed wounded crewmen to be retrieved as well. But once combustion began, the Chieftain burnt like any other AFV on the battlefield and could be completely gutted by fire.

In the meantime, the British and Americans had identified the requirement for a tank gun capable of defeating 120mm of rolled homogenous (RHG) steel armour with an inclination of 60 degrees at a range of 2,000 yards. A joint assessment by ARDE and FVRDE was completed by April 1956 and recommended a 120mm main armament with bagged charge ammunition. Two months later, the concept was embodied in a vehicle with a new Rolls-Royce 90-degree V-8 engine, incorporating an auxiliary engine in the Vee, and an automatic gearbox. Beside the bagged charge concept, its most radical feature was to have the driver in a reclining position when closed down; by this means the vehicle height could be reduced and therefore overall vehicle weight, which was estimated to be approximately 47 tons, kept under control. It was still hoped that this could be reduced by two tons during development to meet the original General Staff weight requirement.

At this time Leyland Motors was appointed as the main design contractor for the new tank that was now designated FV4201 instead of Medium Gun Tank No. 2. The company was heavily committed to the development of the improved models of the Centurion, the Mark 7 and 8, which had priority to meet the requirements of the British Army and overseas customers. As the overall concept of FV4201 had not been finalised as yet, detailed design work was limited to the suspension units, which were to be similar to those of Centurion but suitable for a tank weighing 45 tons. Other suspension systems were considered, such as hydro-gas and torsion bars, but were rejected as the former was too complex and the latter increased vehicle height to an unacceptable degree. Meanwhile, three vehicles were produced to prove the feasibility of the driver's reclining position and the new turret without an external mantlet for the main armament. Based essentially on existing Centurion components, they were designated FV4202 but were known as the '40-ton Centurion' although they weighed nearer 42 tons once completed.

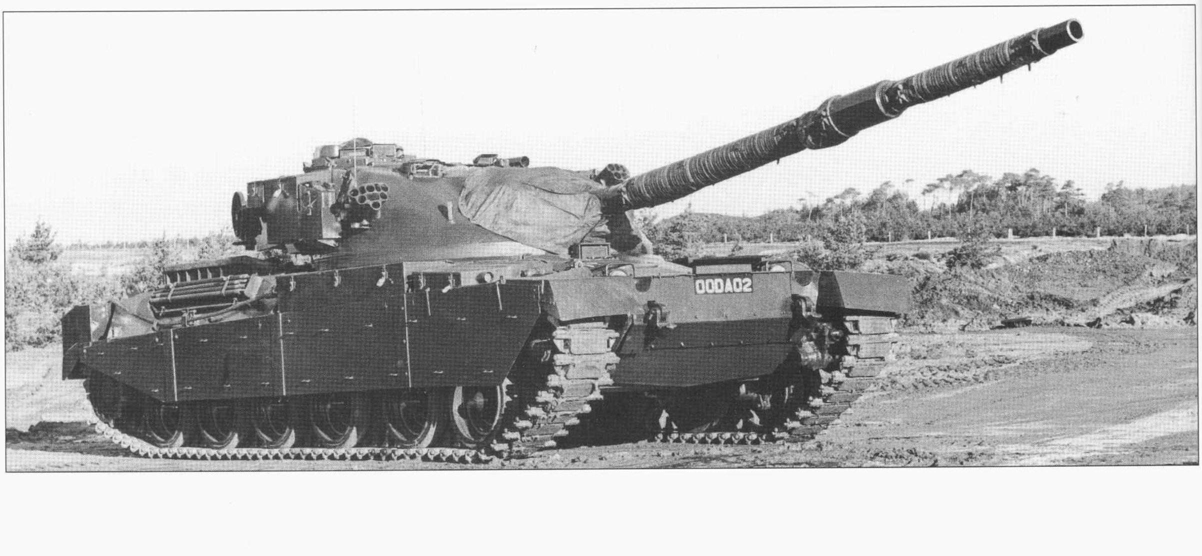
There now followed a short hiatus in the development process as Britain and America tried to incorporate interchangeable assemblies in their respective tank designs. The US Army did not concur with the British findings for a 120mm main armament and preferred a smoothbore gun of 90mm calibre in a tank classified as T-95 although a sister vehicle, the T-96, armed with a 105mm rifled gun was also under development. Like FV4201, the T-95/96 was to weigh 45 tons. In the event, the British were not persuaded by the perceived advantages of the smoothbore weapon and the Americans never took to the bagged charge concept. Nevertheless, much time and effort was expended to make the turrets of FV4201 and T-95 interchangeable on the respective hulls, although to what purpose remains a mystery.

By now, the hull design of FV4201 was well advanced and married to the new suspension units. Various configurations for the vital frontal area of the hull were considered, mainly based on Soviet designs. At first a complex sloping of welded plates similar to the IS-3 was tried but then it was decided to take a step backwards. When the British took over their sector of Berlin after the Soviet occupation in 1945, they found no items of any military significance until one collapsed apartment block was cleared to reveal a IS-2 heavy tank. Instead of welded plates, it featured a cast hull front with well-sloped armour and this was copied for FV4201. Similarly, the turret front of FV4201 was a massive casting which, after a cooling period of at least 12 months, was welded together with the roof and the rear turret section of rolled plate armour.

The design of the turret had also undergone alteration following a revised User Requirement in November 1957 for an increase in gun elevation and depression from +15 degrees and –7.5 degrees to +20 and –10 respectively. This necessitated a larger turret, which inevitably meant an increase in weight, which was compounded by a new User Requirement for infra-red (IR) night-fighting and vision equipment with a 22-in. searchlight/IR projector in an armoured housing on the side of the turret. Furthermore, the Army now demanded an increase in armour thickness on both the turret frontal aspect and glacis plate. Experience in Korea had shown that tanks needed greater protection against strikes from medium artillery shells. Although these did not necessarily penetrate the tank's armour, they could cause weld seams to fail with consequent damage to the interior, so monolithic cast sections for the hull and turret were preferred. By now the weight of FV4201 was rising inexorably but worse was to come.

In late 1957 the standardisation committee in NATO determined that all fighting vehicles within the alliance should be powered by engines capable of running on a wide variety of fuels from standard diesel or kerosene to petrol or domestic heating oil. This decision was to have far reaching consequences for FV4201. The 'multi-fuel policy' had obvious attractions whereby, at the flick of a switch in the driving compartment, military vehicles could refuel from various facilities across Europe be it from a commercial petrol station or an apartment block oil storage tank. In January 1958, to conform with this policy, it was decided to install a new engine for FV4201 and a German compression-ignition, opposed-piston design derived from a Junkers Jumo aviation engine of World War II vintage was chosen for further development as a multi-fuel tank powerplant. Not only did this cause a further delay in the FV4201 development cycle because the engine compartment had to be completely redesigned, it also added a further ton to the weight – which was now estimated to be nearing 50 tons.

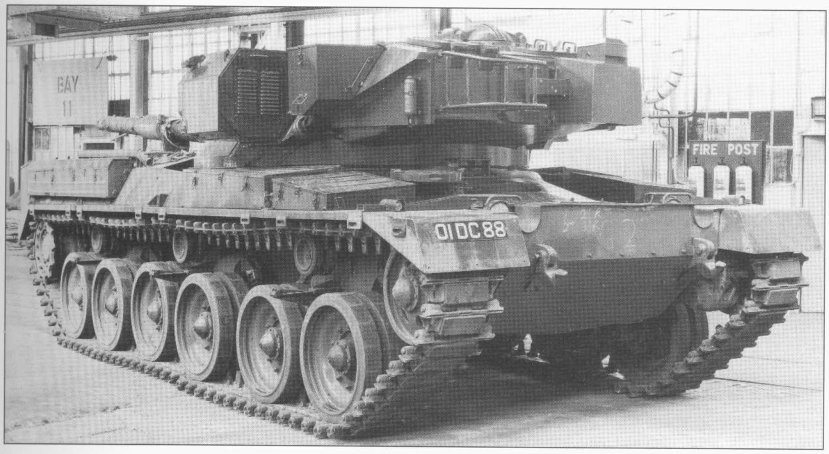
The first prototype of Chieftain out of a batch of six vehicles (P1–P6) was delivered in January 1960 to the Fighting Vehicles Research and Development Establishment at Chertsey in Surrey. A further six prototypes (W1–W6) were delivered between March 1961 and February 1962. 00DA02 was Prototype W4. Here, it is shown soon after its arrival at the Equipment Trials Wing at Bovington, the home of The Royal Armoured Corps, prior to troop trials. This vehicle has the original low suspension with a ground clearance of 17in., which was subsequently increased to 22in. by fitting Centurion roadwheels and by raising the front track adjusting wheel and the final drive assemblies. This modification enhanced cross-country mobility but was achieved with an increase of only one inch in the overall height of the vehicle. At this stage, the turret front and glacis plate were masked by a canvas shroud and sheet metal bin to disguise the armour configuration of the tank.



The compact two-stroke, vertically-opposed piston layout was deemed to be best suited to the multi-fuel requirement because it had fewer moving parts for greater reliability and would be easier to service and have good cold starting characteristics – a significant consideration when operating on the North German Plains in the depths of winter. It is curious that an aviation engine designed for operating in the cold environment of high altitude should be considered suitable for installation in the armoured envelope of a tank engine compartment. Designated the L60, development of the multi-fuel engine proceeded during 1958 at Leyland Motors and a single cylinder test-bed model was running by the end of the year. From the outset, the Royal Armoured Corps (RAC) held severe reservations about the L60 engine but the politicians and their civilian scientific advisers brushed these aside. It proved to be a costly decision. Britain's NATO partners quickly realised that the multi-fuel concept was impracticable and abandoned the idea. Each of the tank-producing countries adopted standard diesel engines that proved reliable and effective. Only the British continued to pursue the multi-fuel concept with an unsuitable engine until it was too late. Ironically, the L60 engine never ran on any other fuel than diesel.

The General Staff issued a consolidated and detailed guide of the characteristics it required for FV4201 on 21 August 1958. In essence, this demanded a tank that combined the firepower of the Conqueror with the mobility of the Centurion and an armour configuration that provided the maximum protection within a weight limit that remained at 45 tons. An increase in top speed to 26mph was also required with a range of 300 miles at a constant 15mph reflecting the need for greater dispersion on the nuclear battlefield. In the same month, Vickers-Armstrong at Newcastle upon Tyne became the main contractor for the design of the turret and for installation of the weapons. Meanwhile, development of the L60 engine continued at Leyland Motors and Rootes Limited. Concurrently, Self-Changing Gears Limited was tasked with the design of the gearbox for FV4201 and the TN12 semi-automatic 'hot-shift' transmission was adopted, based on the TN10 transmission that had originally been developed for the abandoned FV300 light tank series. The first TN12 transmission was completed and subjected to dyna-mometer tests in March 1959.

In the same month, a meeting was convened at FVRDE Chertsey to accept the design of the wooden mock-up of FV4201. Its vital statistics comprised a height of 7ft 10in., a hull length of 22ft 3in., and a ground clearance of 17in. The tank was to carry 60 rounds of ammunition and 250 Imperial gallons of fuel, with an engine developing 700bhp at a crankshaft speed of 2,400rpm giving a power-to-weight ratio of 15.5bhp per ton. Overall weight was calculated to be 100,000 pounds. The design was accepted in principle but, as always, further modi-



Nearing completion at the Royal Ordnance Factory at Barnbow in Leeds, 01DC88 was a pre-production model (G2) and was one of two vehicles given to the Federal Republic of Germany in a bilateral agreement to test each country's tanks then under development. This tank was delivered in November 1962, by when the design was firmly established, with the standard layout of stowage boxes, engine decks, revised exhaust system and the NBC filtration equipment mounted on the turret rear. However, this vehicle has the earlier armoured searchlight housing that was deleted on production models to save weight.

fications and alterations were requested causing further delays although the production of six prototypes (P1–P6) was authorised. In June 1959, six further prototypes of FV4201 (W1–W6) were ordered for troop trials with manufacture shared between Vickers-Armstrong and the Royal Ordnance Factory at Leeds. A further two vehicles were to be built for trials by West Germany following a bilateral agreement to test each country's tanks; Britain received two Leopard 1s for assessment.[2] In September, the TN12 gearbox successfully completed its initial trials and was married with the first low powered version of the L60 engine in a test rig hull. They were subjected to a limited amount of running at Leyland Motors prior to the rig's appearance at the Director of the Royal Armoured Corps (DRAC) conference in December. Prototype P1 was delivered to FVRDE in January 1960 with P2 in April. Both of these were purely automotive models with a circular superstructure in place of the turret, known as the 'Windsor Turret' because of its similarity in shape to the Round Tower at Windsor Castle.

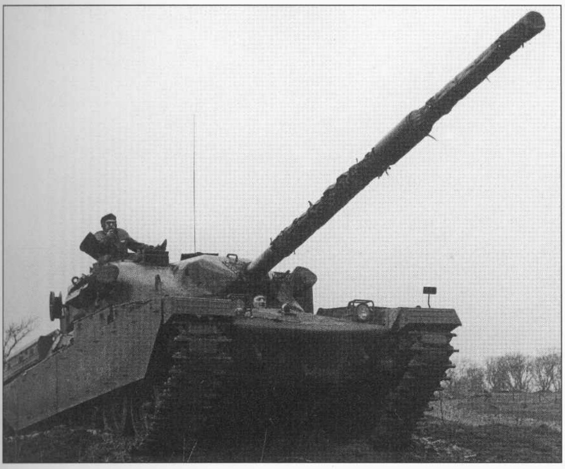
Running trials began in earnest during the early part of 1960, but only on roads and with the engine speed governed to 1,800rpm. Attempts to run the engine on a variety of fuels proved extremely problematical and REME craftsmen of 5MAG (Maintenance Assessment Group) discovered that it would take at least eight hours to modify the feed system for different fuels, an obvious impossibility in the field under combat conditions. The multi-fuel concept was fatally flawed from the outset but the die was cast and FV4201 was now lumbered with an engine whose performance was woefully inadequate and giving cause for grave concern. Many failures occurred due to excessive engine vibration and in the gear train between the top and bottom crankshafts. Problems were also encountered with overheating of the gearbox and the hydraulic fan drives. In time, these problems were ameliorated by various measures, such as reducing the crankshaft speed to 2,100rpm from the intended 2,400rpm and moving the exhaust silencers into an armoured box attached to the rear hull. All these modifications added to the overall weight of the vehicle, which had now risen to almost 50 tons. This in turn meant that the suspension units, which had originally been designed for a vehicle weighing 45 tons, had to be strengthened causing yet a further increase in weight, as did the decision to fit rubber pads to the tracks to conform with German requirements to limit the damage to roads during exercises by the British Army of the Rhine (BAOR). With an engine output of just 500bhp, this gave a power-to-weight ratio of only 10bhp per ton or less than two thirds of the General Staff requirement.

The continual stoppages in the development cycle due to engine and other failures meant that it was impossible to test fully all the other components. For instance, by October 1960 only three gearboxes had completed more than 500 miles with very little cross-country running when the transmission is really put to the test with multiple gearshifts at different loads. Over the next year, as the first new engines with increased power of 550bhp appeared, problems with the gearbox became apparent, particularly with the electrical control solenoids and the input shafts. These problems with the transmission would have been discovered much earlier had it not been for the troubles with the L60 engine that greatly limited the length of automotive trials. Accordingly, there was no time to permit a proper redesign of the problematic assemblies, as it was only possible to take ad hoc interim measures in order to keep the prototypes running and the development cycle in train. This did not augur well for the future.

---

[2] The two Leopard 1s now reside in the reserve collection at the Tank Museum at Bovington and at RCMS Shrivenham; the latter has been cut in half lengthwise for display purposes. The two Chieftain prototypes sent to Germany were W6 and G2.

While Prototypes P1 and P2 continued their difficult testing regime, P3 was delivered to RARDE Chertsey in April 1960 where trials of the gun control equipment were undertaken. For his task of target acquisition the commander was provided with a x10 binocular periscope, while the gunner had a x8 monocular sight linked to the main armament in both azimuth and elevation with an optical link between the two sights. The range to target was established ballistically by a .50-cal. ranging gun mounted parallel to the main armament. Although a hydraulic gun control system for turret traverse and gun elevation, as favoured by the Americans and Germans, was considered, an improved version of the tried and tested electro-mechanical equipment, as used on the Centurion, was adopted for FV4201 despite its greater bulk and slower reaction time because British authorities considered high pressure hydraulic lines to be too dangerous inside the turret.


Production of the Chieftain Mark 1 began in May 1963, at ROF Barnbow in Leeds and at Vickers-Armstrong at Elswick in Newcastle upon Tyne, despite continuing problems with the L60 engine and TN12 gearbox. 40 examples of the Mark 1 were built, but with an engine output of just 585bhp they were only used for training and trials. The Chieftain Mark 1 can be identified by the split hatches on the commander's No. 11 cupola, similar to those on late marks of Centurion.

Firing trials by FVRDE of the L11 120mm gun mounted in W3 began in May 1961 at the Kirkcudbright gunnery ranges in Scotland and later in the year by the RAC at Lulworth in Dorset. Despite serious reservations with the commander's cupola and its machine-gun mounting, these proved highly satisfactory, in complete contrast to those devoted to the tank's automotive performance. Inevitably, there were a number of defects, not least of which was the necessity to replace the original M85 ranging gun with the M2 Browning. The ranging gun system[3] was always seen as an interim measure pending the introduction of a fully integrated laser rangefinder then under development. Firing three-round bursts of tracer ammunition that ignited on striking a hard target, the ranging gun had to be precisely aligned with the main armament to be of use. Once correctly sighted, it was a simple, cost-efficient and robust system that had the advantage of automatically factoring in such variables as trunnion tilt and crosswinds, but in the early days was only effective out to a range of 1,500 yards which rather negated the long-range capability of the 120mm main armament. Prototypes P3 and P4 also conducted firing trials at Kirkcudbright, including the IR night-fighting equipment, during 1962.

Throughout this period, the prototype vehicles were constantly being modified or reworked to the latest standards. They were then sent on different trials with either FVRDE or service personnel. By now, it was decided to despatch two FV4201 vehicles, now named Chieftain, to BAOR for troop trials with operational units in the field. The two units concerned were the 1st and 5th Royal Tank Regiments (RTR), stationed at Hohne and Fallingbostel

---

[3] The Browning .50-cal. ranging gun as used in late marks of the Centurion and early marks of the Chieftain is often referred to as 'the ranging machine gun' but during an interview with Major Bert Starr MBE, the doyen of the RAC Gunnery Wing at Lulworth for many years, the author was remonstrated with for using such a term. As Major Starr wrote most of the gunnery training manuals of the period in question, his terminology of 'ranging gun' is used here.

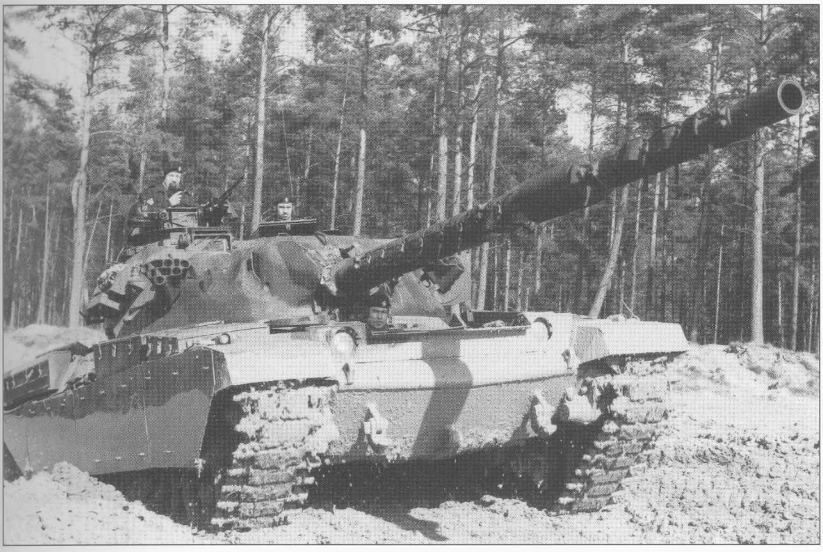
A line of Chieftains Mark 2 of the 4th/7th Royal Dragoon Guards prepares to move off during a training exercise at Soltau in West Germany in 1969. The main identifying difference from the Mark 1 is the new contra-rotating commander's No. 15 Mark 1 cupola with its single-piece hatch.

respectively. During 1962 selected crews were sent from Germany to FVRDE, Bovington and Lulworth for initial familiarisation and training. In late December W1 and W3 arrived in Germany under conditions of great secrecy with one going to each regiment. The trials were to last three months.

First impressions were good. In the harsh winter conditions the rubber track pads of the Chieftain were a considerable aid to mobility on the icy roads as against the steel tracks of the Centurion that skidded and slid with gay abandon. However, the same wintry conditions soon revealed the worst aspect of Chieftain as far as its crews were concerned – which was to be an issue throughout its career – the lack of an internal heater, the victim of one of the perennial weight saving measures. Furthermore, when the spring thaw came, the Centurion was better able to negotiate the muddy conditions than the Chieftain due to the latter's low ground clearance of 17in. This was subsequently raised to 22in. by substituting Centurion road wheels and modifying the suspension but with an overall increase of vehicle height of just an inch. Automotively, the tanks performed adequately although there were several gearbox failures and its limited power output meant it had only comparable cross-country mobility to the Centurion Mark 7 against which it was paired for trials purposes.

As to gunnery, various deficiencies became apparent, not least of which was the workload for the loader/radio operator who had to maintain and serve three weapons and the radios as well as providing the crew with hot drinks and meals from the BV or boiling vessel mounted behind the main armament. But worst of all was an electro-mechanical device for ramming the projectile into the breech that was totally unreliable and a real hazard to the loader himself. The RTR 'tankies' quickly devised an alternative means to seat the projectile by using the Combustible Cartridge Case (CCC) itself as a rammer. Despite official disapproval, this became the standard method of loading. The complex electro-mechanical device was discarded and was not fitted to production vehicles. The culmination of the trials was a 72-hour 'closed-down' exercise whereby a 5RTR crew manned a Chieftain for a three-day period without opening any hatches at all while a reserve crew refuelled and serviced the vehicle from the outside. Each day, the tank had to undertake at least ten hours of motoring over all manner of terrain, while all equipment such as radios and gun stabiliser were operating, in order to test everything fully. The exercise ended with a comprehensive shoot on Hohne Range 7A with all ammunition being expended in an orgy of destruction before an audience of high-ranking officers and RAC personnel.

Although generally successful, the trials demonstrated that there were still many faults to be rectified before series production could begin.



A Chieftain Mark 2 of the 3rd Royal Tank Regiment churns through the mud during the spring thaw at Fallingbostel in West Germany in April 1962. Above the main armament is the coaxial L8A2 7.62mm machine gun and at the commander's cupola is the L37A2 7.62mm machine gun. On each side of the turret is a No. 9 discharger that is capable of firing six grenades at once to create an instant smoke screen and mask the tank from enemy observation as it seeks cover among trees or dead ground. Like the first Chieftain model, the Mark 2 has two jerrycan holders on the right-hand side of the turret.

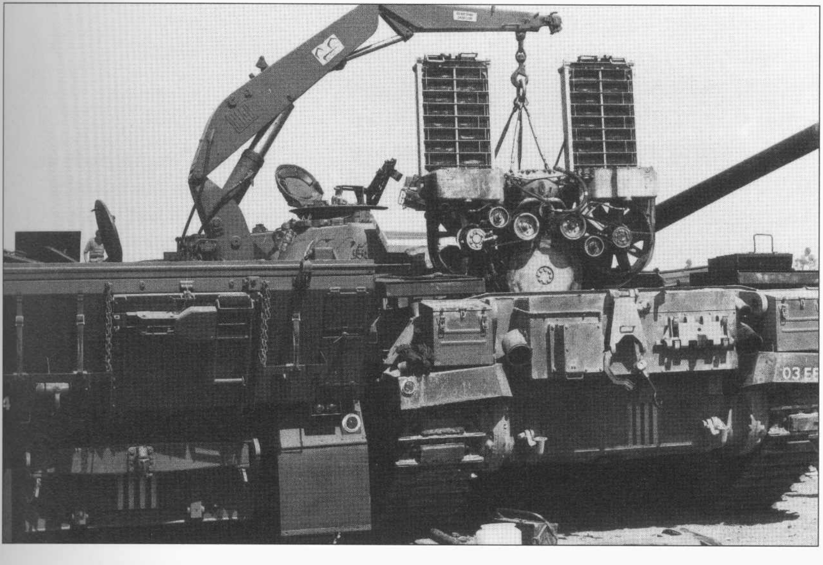
Despite the demands of many in the high command who wished for the new Main Battle Tank (MBT) as soon as possible, further development, particularly of the engine and transmission, was necessary. Nevertheless, the Chieftain was accepted for service on 1 May 1963 to allow production to start, but over the next two years only an extra 35bhp could be squeezed out of the L60 engine before it equipped the Chieftain Mark 1 of which 40 were built – in fact there was one pre-production model and 39 to the Mark 1 specification. Deliveries were made between mid-1965 and early 1966 with 26 being manufactured by the Royal Ordnance Factory (ROF) Leeds and 14 by Vickers-Armstrong. In the event, the Mark 1 was only used for troop trials and training; one of the first Chieftains to arrive at the School of Mechanical and Electrical Engineers (SEME) Bordon was so underpowered that it was incapable of climbing onto a tank transporter. The first proper Chieftain model, the Mark 2, was delivered to the British Army from ROF Leeds on 18 April 1966. The first armoured regiment to be equipped with the new MBT was the 11th Hussars (Prince Albert's Own) – The Cherrypickers – which received its first six Chieftains in November 1966.

In the same month, a delegation from the Israel Defense Forces (IDF) arrived in Britain to study the Chieftain. For years the IDF had been forced to acquire tanks from a wide variety of sources, be they East or West. As a result, the Israeli Armoured Corps was determined to produce its own battle tank, following a decision in February 1964, so as to ensure a continuity of supply. At first the Israelis wished to assemble the French AMX-30 tank in Israel as, hitherto, the French had been the most reliable supplier of weapons to Israel from the West. The intention was for the Israelis to assemble the chassis locally with the turrets being imported from France. By this time the Centurion was in widespread service with the IDF and the Israeli Armoured Corps, under the dynamic leadership of Major-General Israel Tal, was more inclined to the British school of tank design rather than the French belief in high mobility at the expense of armour protection. After protracted discussions, while the Foreign and Commonwealth Office dithered for fear of offending Arab opinion, the British agreed to sell Chieftain to the IDF including setting up a production line in Israel. Initially, the tanks would be assembled in Israel from kits supplied from Britain before full production was undertaken in the country. In return, the Israelis agreed to share development costs and provide their particular expertise in operating tanks in desert conditions.

Two Chieftains Mark 2 arrived in Israel for trials with the IDF in early 1967, but within months the region was plunged into conflict with the outbreak of the Six Day War in June. The nervous Foreign Office cabled Tel Aviv and demanded that the Chieftains be moved from the border regions of the Negev Desert with Egypt for fear of Arab accusations of collusion with the Israelis. The Israelis sent a laconic reply, 'Have no fears, we have moved the borders.' After extensive testing, the two Chieftains were replaced by new models and the desert trials continued, providing a wealth of data on operating in hot climates. On 17 October 1968 the Israeli government made an official request to Britain to purchase the Chieftain. In April 1969 another Israeli delegation arrived in Britain to study production methods at ROF Leeds and Vickers-Armstrong, but the British government was in a quandary with the Ministry of Defence in favour of the deal and the Foreign Office increasingly opposed to it for political reasons. The diplomats prevailed and in December 1969 Britain officially informed Israel that its request to produce Chieftain was refused. In the same month both Chieftains were returned to Britain. Nevertheless, the British learnt a considerable amount from the Israeli trials and incorporated numerous improvements into production models, such as cupola periscopes angled to reduce solar reflections. With stunning duplicity, Britain then offered these Chieftain models to several Arab powers, including Libya and Iran – such is *realpolitik.*

The next major variant, the Chieftain Mark 3, first rolled off the production line at ROF Leeds on 16 September 1969. It featured an improved life L60 Mark 5A engine of 650bhp and many other enhancements. Even so, the Chieftain remained underpowered for a tank now weighing 53 tons and even more worryingly the L60 engine was increasingly plagued with problems of reliability. It was apparent that the attempts to increase engine output had resulted in reduced reliability. Furthermore, whenever one problem was partially solved, another component within the power train began to suffer repeated breakages. There were four main aspects of engine failure: cracking of the cylinder liners; failure of the cylinder lip seals; piston fire ring breakages; and cracking of the rear gear cases. All these problems were eventually resolved but not before Chieftain's reputation had been irredeemably compromised. The first engine modification programme was known as Totem Pole and was combined with other improvements to upgrade all previous marks of Chieftain to the same standard as the final production vehicle for the British Army, the Mark 5.

Major General Israel 'Talik' Tal stands with a British officer in front of one of the four Chieftains Mark 2 tested by the Israeli Armoured Corps between 1967 and 1969. Although the Israelis wished to manufacture the Chieftain under licence, the British government eventually refused and the tanks were returned to the UK. General Tal was the leading light behind Israel's first indigenously produced MBT – the Merkava. (The Tank Museum)



When the Chieftain first entered service, it suffered recurring gearbox failures. In the early 1970s, the Chieftain was bedevilled by serious engine problems that were a constant source of breakdowns in the field. The situation became so bad that all Chieftains were taken off the road leaving the British Army's contribution to NATO severely compromised. Following the implementation of the Sundance programme, reliability improved but the target engine life of 4,000 miles was rarely realised. For years the L60 was prone to producing clouds of exhaust plumes that were readily visible on the battlefield. The two-stroke engine also had a very distinctive sound that was audible over long distances that was a further tactical liability. A new starting technique introduced in 1983 ensured better lubrication of the upper crankshaft, which significantly increased the durability of the engine. By the time of the introduction of Challenger, Chieftain availability was in the order of 80 per cent and considerably better than its successor. During the Gulf War in 1991, the Chieftain special purpose variants of the Royal Engineers and REME achieved the remarkable Mean Distance Between Failures of 3,792km; well over twice that of Challenger.

This version subsequently incorporated the L60 Mark 8A engine of 750bhp at 2,250rpm giving a top speed of 30mph (48km/h) with a road range of 310 miles (500km). The Mark 5 was the definitive Chieftain model. It weighed 54.8 tons which was almost ten tons greater than the original General Staff requirement, an increase of almost 25 per cent.

The problems of engine reliability became so bad that an investigation was undertaken by the Expenditure Committee and the Defence and External Affairs Sub-Committee of the House of Commons and their findings were published in 1978 – (*The Chieftain Tank Engine* – HMSO London 23 May 1978). Its conclusions were damning – "The performance of the Chieftain's gun and range-finding equipment is first class. It is therefore all the more unsatisfactory that the tank should have been let down by its engine in the past. It is difficult to feel confident about the future performance of the engine in the light of the subsequently unfulfilled assurances given by the Ministry of Defence... We wish to assure the House that the present programme of engine modifications, as it has been explained and demonstrated to us, appears to be meeting with success so far... Nevertheless, despite these welcome improvements, we cannot avoid observing in conclusion that the saga of the Chieftain tank is not one which reflects well on the Ministry of Defence, even allowing for an element of sheer bad luck in the problems which have dogged the engine. It is only right to point out, moreover, that, assuming the present programme of modifications represents the final instalment, it will be well over half way through the Chieftain's active life before it has an engine to match its other undoubted assets."

TECHNICAL DESCRIPTION OF THE CHIEFTAIN MARK 5

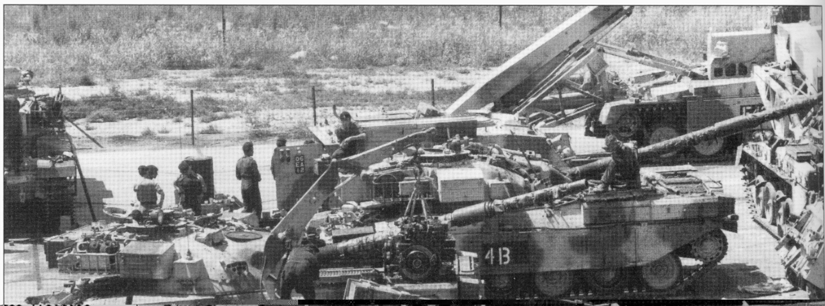
The design of any tank is essentially a compromise between three fundamental but mutually conflicting factors – firepower, mobility and protection. The key function of a tank is to defeat enemy armour so heavy firepower is the primary requirement for the designer. But the heavier the weapon, the larger the turret must be to house it and its associated ammunition, which in turn requires a larger hull to accommodate it. The larger the hull and turret, the heavier they must be if they are to incorporate adequate armour protection but armour is very heavy and thus added armour requires an engine of much greater horsepower to achieve adequate mobility. The greater the horsepower, the larger the engine but this in turn requires a larger hull to house the bigger engine which means more weight and so it goes on inexorably.

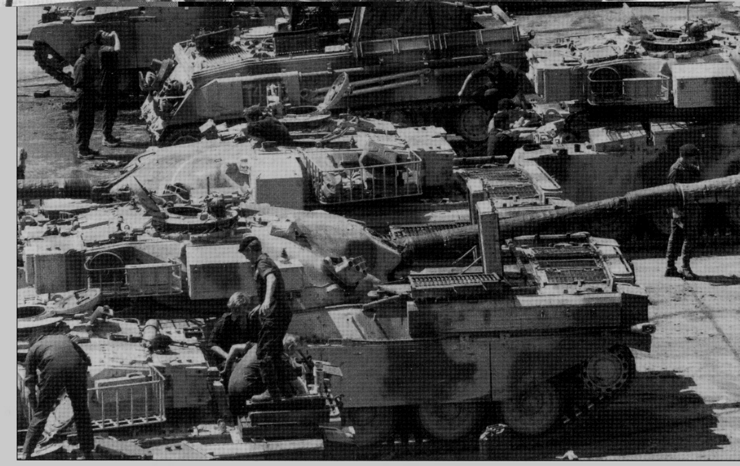
Although many innovative concepts were addressed at the outset, the Chieftain emerged as a conventional design with a four-man crew and a fully-rotating turret housing the main armament on a hull divided between the driver's compartment at the front, a central fighting compartment, and the engine, gearbox and cooling assemblies at the rear that delivered power to the rear-mounted drive sprocket and propelled the fully tracked vehicle.

The driver is located centrally in the front hull with ammunition charge bins and batteries on each side. His seat can be reclined for driving when closed down. This also allows him a means to escape into the fighting compartment in an emergency, as well as providing a comfortable bed at night. The driver controls the vehicle by means of two steering levers located on each side of his seat; by pulling the right-hand lever, the vehicle turns to the right and so on. Above his position is a single piece 'lift and swing' hatch to allow entry and egress at all points of turret traverse. Behind the driver's hatch is a single wide-angle AFV No. 36 Mark 1 periscope that can be replaced by an IR or passive night sight. To his front is the main instrument panel below which are three foot pedals with from right to left the accelerator, brake and the gearbox controller, which works on the same principle as a motorcycle gearshift whereby 'toeing' the lever upwards engages a higher gear ratio and toeing down a lower. The selected gear ratio also determines the radius of turn with the lower the gear, the tighter the turn for manoeuvring in confined areas. The driver has two switchboards, for the GUE or Generating Unit Engine and the main engine respectively. Usually referred to as the 'aux gen' or 'genny', the GUE is used to start the main engine, so saving on battery power, and to charge the batteries themselves. It also provides electrical power for the gun control equipment and BV during silent watch periods when it is tactically unsound to run the main engine.

The fighting compartment is located centrally and extends to the full width of the hull with the turret suspended on a ball race to allow 360-degree rotation. The other three crew members are housed in the turret, with the commander and gunner seated to the right of the main armament and the loader/radio operator to its left. The commander is provided with a No. 15 Mark 2 cupola that can be traversed through 360 degrees. It provides all-

In the 1970s the Chieftain was plagued by engine reliability problems. In a parliamentary investigative report published on 23 May 1978 the House of Commons Technical Affairs Sub-Committee concluded: 'The performance of the Chieftain's gun and range-finding equipment is first class. It is therefore all the more unsatisfactory that the tank should have been let down by its engine in the past.' The problems of the L60 engine were exacerbated by the inadequate provision of spare parts and replacement powerplants. Nevertheless, when Chieftains were used on a regular basis, such as those at BATUS in Canada, they proved to be much more reliable than average. These Chieftains are undergoing routine maintenance at the BATUS workshops prior to an exercise on the Canadian prairie in 1979.





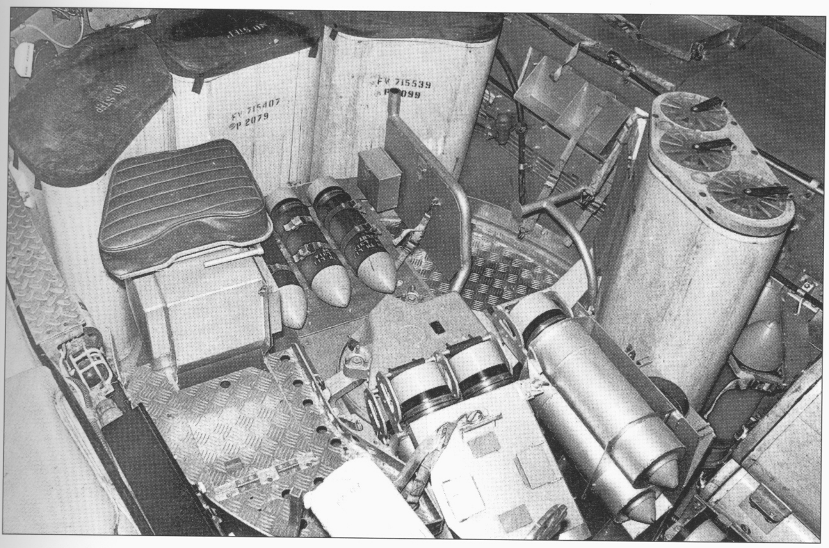
round direct vision through nine AFV No. 40 Mark 2 observation periscopes and a single AFV No. 37 Mark 4 sighting periscope. On the exterior of the cupola is a spotlight and an L37A1 7.62mm machine gun. The gunner is seated forward of the commander and he has two primary sights, the persicopic AFV No. 59 which protrudes through the roof and the direct vision AFV No. 70 telescopic sight. At night both the gunner and commander can replace their daytime sights with infra-red (IR) versions. Mounted on the left-hand side of the turret is a 2kw combined white light and IR projector capable of identifying targets out to a range of 1,000m in the IR mode. The Chieftain can also be fitted with an IR detector above the roof that gives an audible and visual warning when an IR source is illuminating the tank. The loader is provided with a single rotating periscope AFV No. 30 Mark 1 and a two-piece hatch in the roof.

The loader also acts as the radio operator and the basic equipment for this function initially comprised the Larkspur C42 and B47 sets with integral intercommunications for all the crew members; the Larkspur was later superseded by the Clansman range of radio equipment. As loader, he serves and maintains the main armament, the L21A1 ranging gun and the L8A1 co-axial 7.62mm machine gun by providing a constant flow of ammunition and clearing any stoppages or misfires that might occur.

The L11 120mm high-velocity rifled tank gun is fitted with a fume extractor half way down the barrel which is also wrapped in a thermal sleeve to minimise distortion of the tube and therefore loss of accuracy at long ranges due to differential heating or cooling. The gun has a vertically sliding breech block, which opens automatically after firing. After placing the projectile in the breech, the loader rams it home with the bagged charge and closes the breech. He then trips a safety switch and the weapon is ready to fire by means of an electrically initiated vent tube. The gunner lays the weapon on the target following directions from the vehicle commander. The Fighting Vehicle Gun Control Equipment (FVGCE) No. 7 Mark 4 provides various modes of operation including full stabilisation to allow accurate firing on the move.

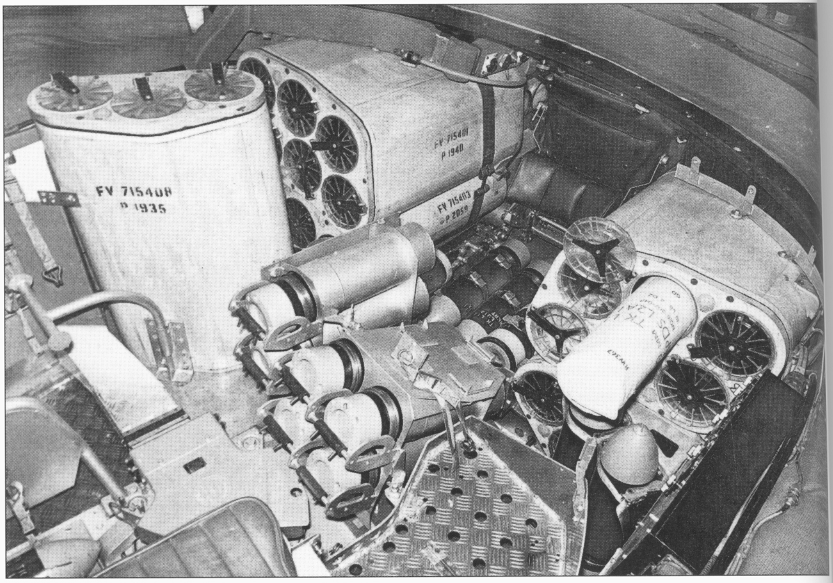
The range to target is established by firing three-round bursts of the .50-cal. ranging gun using four predetermined graticule marks in the gunner's sight. Whichever burst strikes the target indicates which main armament graticule mark must be used to lay on the target and the gun is then fired. The ranging gun system was superseded by the Tank Laser Sight (TLS) which has an accuracy of +10m at its maximum operating range of 10,000m. The TLS was later integrated with the Improved Fire Control

This series of photographs depicts the interior of a late production model Chieftain Mark 5 produced for foreign military sales.
A: A view from the gunner's position looking backwards with the commander's seat at left with charge bins behind and HESH rounds stowed on the floor and beneath the main armament – all these explosive rounds are stowed below the level of the turret ring for greater survivability.



System (IFCS) to give the Chieftain the ability to exploit fully the superior firepower of the L11A2/A5 Tank Gun as against the L7 105mm of most of its contemporaries.

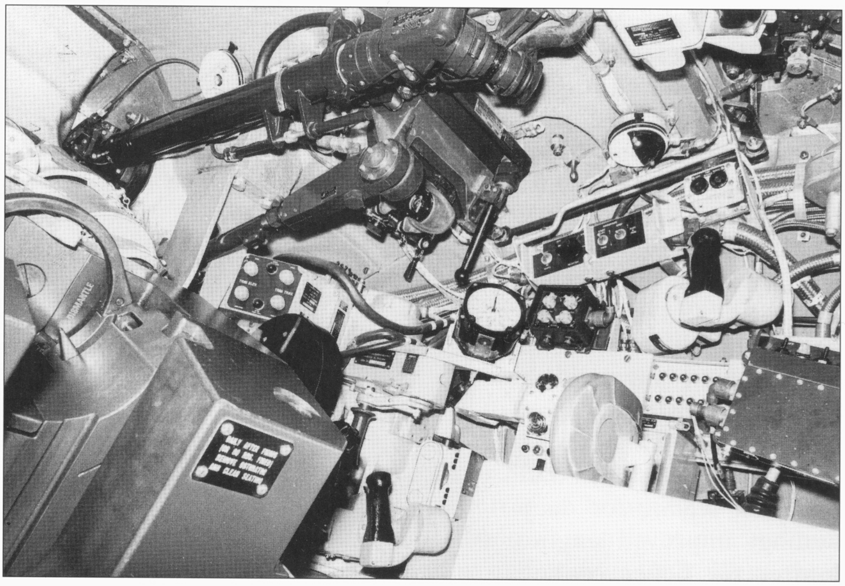
At the rear of the tank is the engine compartment housing the L60 engine, TN12 gearbox, final drives and cooling assemblies. The Chieftain Mark 5 featured the L60 Mark 7A of 720bhp and later the Mark 8A of 750bhp. The TN12 gearbox incorporates a Merritt Wilson differential steering unit and epicyclic gear change system with six forward and two reverse gear ratios plus an emergency mechanical selector of second gear forward and low reverse. A three-cylinder Coventry Climax H30 No. 4 compression-ignition auxiliary engine is also fitted in the engine compartment to provide electrical power and a facility for starting the main engine. The Horstmann suspension consists of three double bogies each side, with the drive sprocket at the rear, a front idler and three top return rollers. The tracks are of cast steel, with 96 links each when new, and each track link has a detachable rubber pad for either combat or peacetime conditions.



B: A view looking forwards and downwards from the commander's position with charge bins to each side of the driver's seat.

The Chieftain Mark 5 was the final production model for the British Army although there were many subsequent marks and sub-marks (see below). Almost 1000 Chieftain MBTs were built for the British Army and an equal number for foreign armies. In 1971, the Imperial Iranian Army ordered 792 Chieftains including 707 Mark 3/3P and 5P MBTs, 71 Chieftain ARVs (fitted with Atlas cranes) and 14 AVLBs. In 1975, the Iranians ordered a further 187 improved Chieftains designated FV4030/1 with enhanced mine protection; greater fuel capacity; additional shock absorbers and an automatic gearbox to simplify driver training. However, Iranian dissatisfaction with the L60 engine led to a requirement in December 1976 for the complete tank fleet of Chieftains to be modified to accept the Rolls-Royce CV12 that was being developed for the Shir 1 and 2 FV4030 models. A design study by the Ministry of Defence Procurement Executive decided that a derated version of the CV12 of 800bhp be used to avoid significant changes to the gearbox, final drives and cooling system. On 11 July 1977, the Shah of Iran authorised the modification programme but the Iranian revolution in 1979 brought about its cancellation. In May 1976, the Kuwaiti army took delivery of the first of 165 Chieftain Mark 5/2K MBTs. In August 1981, the Sultan of Omans Forces acquired 12 Chieftain Mark 7/2 C MBTs on loan from British Army stocks. These were subsequently purchased by Oman as were 15 new build vehicles designated Qayd Al Ardh after a famous desert warrior. A total of 2,265 Chieftain MBTs were produced between 1965 and 1985 in Leeds and Newcastle.

C: A view looking upwards from behind the breech to the gunner's position showing the fire control system.



CHIEFTAIN VEHICLES AND VARIANTS

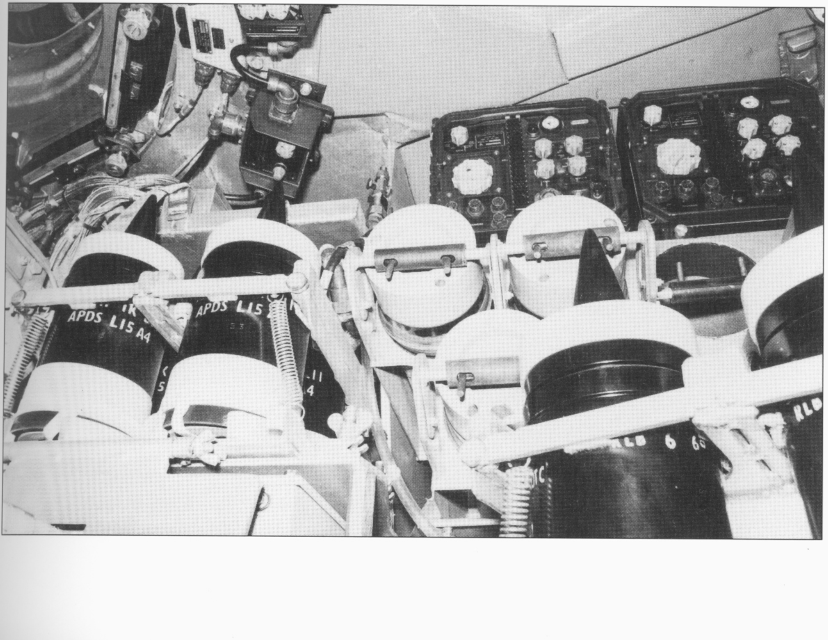
FV4201 prototypes

P1–P6 delivered between January 1960 and November 1962. W1–W6 delivered between March 1961 and April 1962. G1 and G2 delivered in January and November 1962.

Mark 1

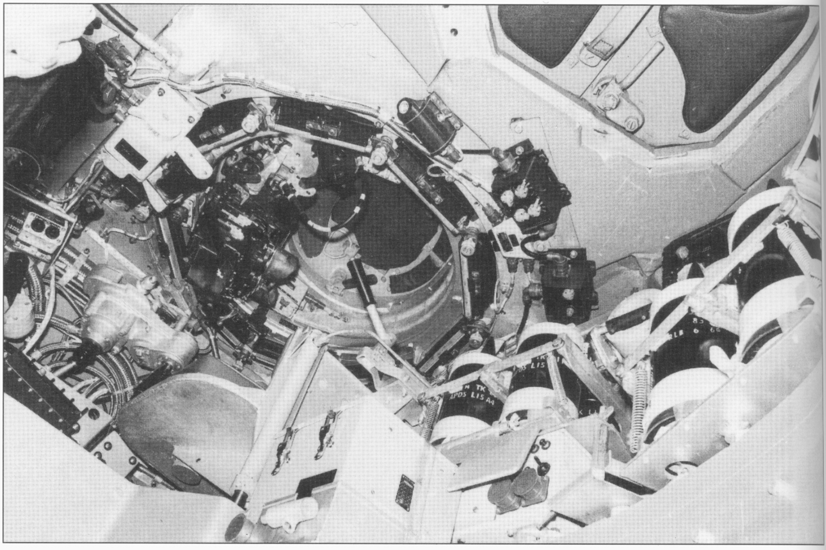
First production vehicle with 585bhp engine. Hull of welded rolled steel plate with cast glacis plate. Turret of cast steel with rolled steel plate roof and bustle. No. 11 Mark 1 commander's cupola with split hatches. One pre-production model to Mark 1 specification and 39 Mark 1 vehicles built at ROF Leeds (26) and Vickers-Armstrong (14). Vehicles despatched from ROF Leeds between June 1965 and February 1966.

D: A view looking upwards from the loader's position showing the installation of the Clansman radios and the stowage of APDS projectiles.



Mark 1/1 Basic Mark 1 with automotive improvements to exhaust system and addition of main engine air cleaner restriction warning.

Mark 1/2 Basic vehicle with No. 15 Mark 1 cupola in place of No. 11; improved exhaust system; improved smoke dischargers; top rollers fitted with floating seals; four headlights with two IR and two white; main engine air cleaner restriction warning. All changes made during UK base overhaul.



E: A view from the loader's position looking up to the commander's cupola. In the centre is the BV or boiling vessel beloved of all British tank crews for brewing tea and cooking combat rations.

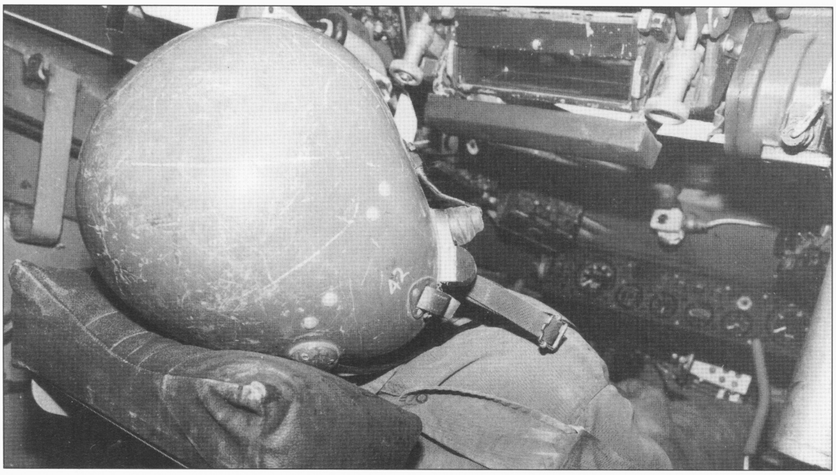
Mark 1/3 Basic Mark 1 modified to Mark 1/1 and 'Totem Pole' conversion.
Mark 1/4 Mark 1/2 with 'Totem Pole' conversion. 11 examples subsequently converted to Chieftain Mark 6 AVLB in 1986.

Mark 2

Vehicle with 650bhp engine; new turret with improved ballistic protection; No. 15 Mark 2 cupola; exhaust system and rear hull sealing for deep wading; improved engine louvres for better cooling and accessibility; Mark 1/2 modifications incorporated during manufacture. First mark to enter operational service with the British Army. First delivery from ROF Leeds on 18 April 1966.
Mark 2 (X) Mark 2 with X Programme of 'Totem Pole' conversion only.
Mark 2 (Y) Mark 2 with Y Programme of 'Totem Pole' conversion only.
Mark 2 (Y)/L Mark 2 with fitting of 'L' kit for Tank Laser Sight 'C' or No. 1 Mark 1.
Mark 2 (Y)/1 Mark 2 with TLS No. 1 Mark 2 or No. 3 Mark 1 and Stage 1 Muzzle Reference System (MRS).
Mark 2 (Y)/2 Mark 2 on completion of TLS No. 1 Mark 2 and MRS installation.

Mark 3

Basic Mark 2 with stronger suspension units, oil-filled axle arms, track tensioner and top rollers; improved life 650bhp L60 Mark 6A engine, with fan drive and dust extractor; improved performance and reduced weight H30 Mark 10A GUE; improved starting system for low temperature operations; improved ammunition stowage fittings; strengthened trackguards;



The driver in his closed-down supine driving position.

No. 15 Mark 2 commander's cupola with periscopes angled to minimise solar reflection and L37A1 7.62mm machine gun; improved 12:1 ratio parking brake; easier access to rear of turret for gun barrel removal; four headlights with two IR and two white lights.

Mark 3 (X) Mark 3 with X Programme 'Totem Pole' conversion only.

Mark 3 (Y) Mark 3 with Y Programme 'Totem Pole' conversion only.

Mark 3 (Y)/L Mark 3 with 'L' kit for TLS 'C' or No. 1 Mk 1.

Mark 3 (Y)/1 Mark 3 with TLS No. 1 Mark 2 and Stage 1 MRS.

Mark 3 (Y)/2 Mark 3 on completion of TLS No. 1 Mark 2 and MRS installation.

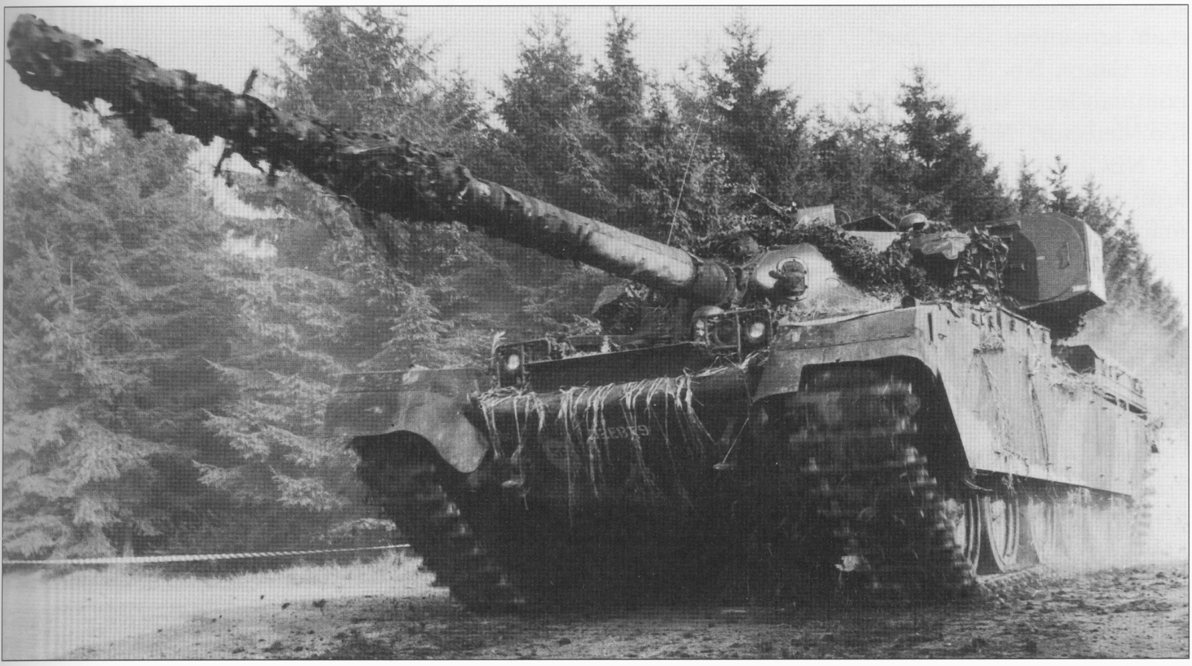
Mark 3/G Originally classified as Mark 3/1, the vehicle had turret air breathing for engine aspiration. Only 6 of this model were built at ROF Leeds for Iran but were transferred to the British Army. Completed in October 1969.

Marks 3/G (X) to 3/G (Y)/2 As for Mark 3 (X) to Mark 3 (Y)/2.

Mark 3/2 Modified Mark 3/G to test turret air breathing and normal engine aspiration; commander's cut-out switch for main engine and own firing switch; prototype laser mounting and wiring. Only 17 of these vehicles were built at ROF Leeds for the British Army between December 1969 and May 1970.

Marks 3/2 (X) to 3/2 (Y)/2 As for Mark 3 (X) to Mark 3 (Y)/2.

Mark 3/S Production model of Mark 3/G with turret air breathing facility as well as normal engine aspiration; improved main engine air cleaner system; reduced capacity main engine oil tank and modified lubrication pipe work for new air cleaner system; commander's cut-out switch for main engine and commander's firing switch; new type gunner's handwheel with firing switch; anchor block for HESH extractor tool. 40 were built for the British Army by ROF Leeds between January and May 1971. The S of Mark 3/S stood for Sandman and represented the synthesis of the Israeli trials of Chieftain.



With its main armament masked with camouflage netting, a Chieftain Mark 2 of The Life Guards advances at speed during autumn exercises in West Germany in 1981. This vehicle shows the dual IR headlights on either side of the glacis plate splashboard. The .50-cal. ranging gun is readily apparent beside the 120mm L11A2 Tank Gun.

Marks 3/S (X) to 3/2 (Y)/2 As for Mark 3 (X) to Mark 3 (Y)/2.

Mark 3/3 and Mark 3/3P Mark 3/S with modified hull to accept 720bhp L60 Mark 7A engine; improved engine air cleaner; reduced capacity main engine oil tank; exhaust system twin silencers replaced by single expansion chamber; engine and transmission louvres redesigned and mesh screen added; fuel tank isolation valve; No. 59 gunner's day sight fitted with graticule for use with extended ranging gun ammunition and production type laser mounting and wiring; separate Metadyne compartment and improved Metadynes; redesigned NBC (Nuclear, Bacteriological, Chemical) pack No. 6 Mark 1; driver's hatch securing clamps redesigned; inflatable turret sealing ring deleted; battery heating system fitted. Built between May 1971 and February 1972, the P of Mark 3/3P standing for Persia as 44 of the 100 manufactured at ROF Leeds were for Iran.

Mark 4

Two vehicles built at ROF Leeds to Israeli specification but Israeli production order cancelled in December 1969. 02SP95 and 02SP96 were completed in June 1970 and underwent desert trials at the US Army Yuma Proving Ground in Arizona between May and September 1971. 02SP96 subsequently reworked with Hydrogas suspension system as part of the FV4030 development programme.

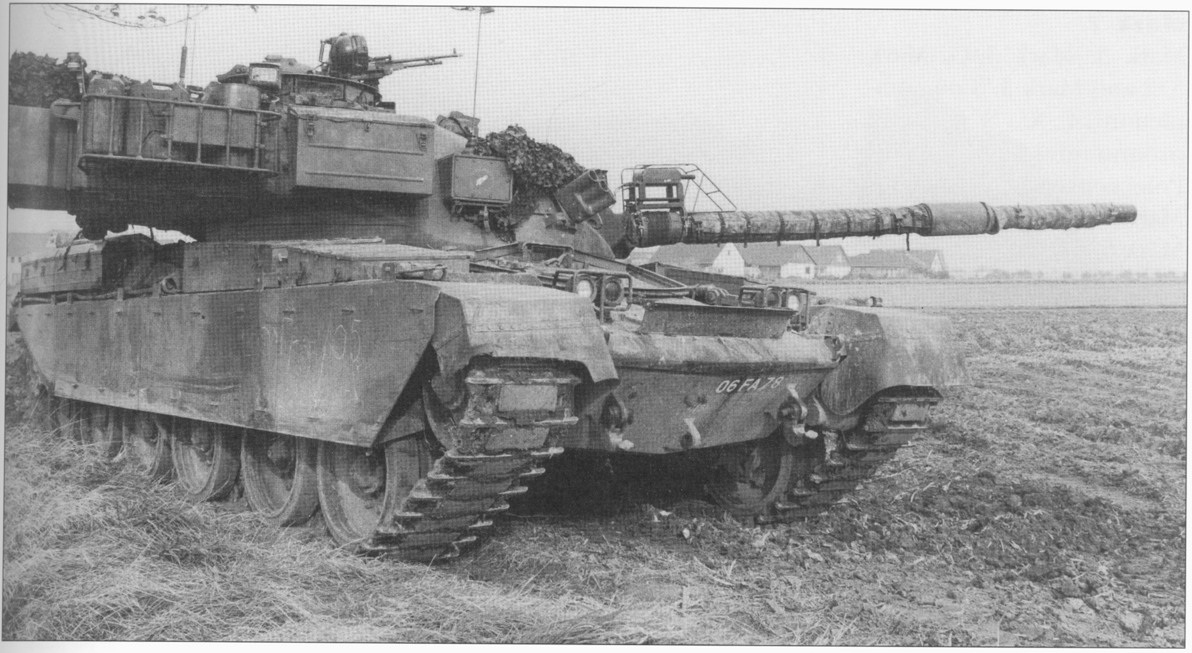
Mark 5 and Mark 5/P

Definitive Chieftain model developed from Mark 3/3 with 720bhp L60 Mark 7A engine; strengthened gearbox; new low-restriction exhaust system; revised air cleaning filters for GUE; battery heating and lagging for enhanced starting; revised engine and transmission covers; improved No. 43 gunner's telescope mounting; gunner's telescope and commander's collimator fitted with graticule for extended range ammunition for ranging gun; 50 per cent reduction in ranging gun ammunition capacity; modified charge bins; ammunition stowage increased to 64 rounds of 120mm; new thermal sleeve for main armament and revised gun clamp; No. 37 Mark 4 commander's sight; infra-red detector; No. 6 Mark 2 NBC pack as standard; commander's cupola machine gun capable of elevation to 90 degrees. First vehicle delivered from ROF Leeds in March 1972. Mark 5/P for Iran to same build standard.

Mark 5/L Mark 5 with fitting of 'L' kit for Tank Laser Sight 'C' or No. 1 Mark 1.

Mark 5/1 Mark 5 on completion of TLS No. 1 Mark 2 or No. 3 Mark 1 and MRS installation.

A Chieftain of The Royal Hussars thunders across a training ground in West Germany during 1981. This vehicle was originally a Mark 2 but, by 1981, it had been modified by the installation of IFCS and MRS as well as Totem Pole so had become a Mark 2(Y)/2. However, it is impossible to identify specific sub-marks of Chieftain from the exterior because the majority of modifications during its long career were internal.



A Chieftain Mark 3 C of The Queen's Own Hussars pauses beside a tree line during Exercise Full House in West Germany during 1978. The vehicle is fitted with Simfire equipment, subsequently Simfics after the introduction of IFCS. Manufactured by the Solartron Electronic Group, Simfire and Simfics comprised: an eye-safe laser projector above the main armament; a flash/bang generator that simulated the main gun firing by sound, flash and smoke and a set of five laser pulse detectors around the turret; a data processing unit inside the tank and, on the roof, a radio link to communicate engagement data to the exercise umpires. This vehicle is also equipped with the new Clansman radio system, which can be identified by the Aerial Tuning Unit box on the side of the turret behind the smoke discharger. When fitted with Clansman radios, all Chieftain marks, from the Mark 2 onwards, were given the suffix C.

Mark 5/2 and Mark 5/2K Mark 5 on completion of TLS No. 1 Mark 2 or No. 3 Mark 1 and MRS installation. The K of Mark 5/2K stood for Kuwait with 165 of this version built by ROF Leeds and Vickers. First Mark 5/2K delivered from ROF Leeds in May 1976.

Mark 5/3P Stage 1 of FV4030 Project for Iran. Improved Mark 5/P with increased mine protection; extra fuel capacity; shock absorbers on first and third suspension bogies; automatic gearbox. 193 built by ROF Leeds with first delivered in July 1976.

Mark 5/3 Mark 5 on completion of TLS, MRS and Improved Fire Control System (IFCS) and modifications to commander's cupola.

Mark 5/4 Mark 5 with modifications for stowage of APFSDS ammunition and revised sight graticule.

Mark 6

Mark 2 on completion of 'X', 'Y' and 'Z' programmes of 'Totem Pole' conversion.

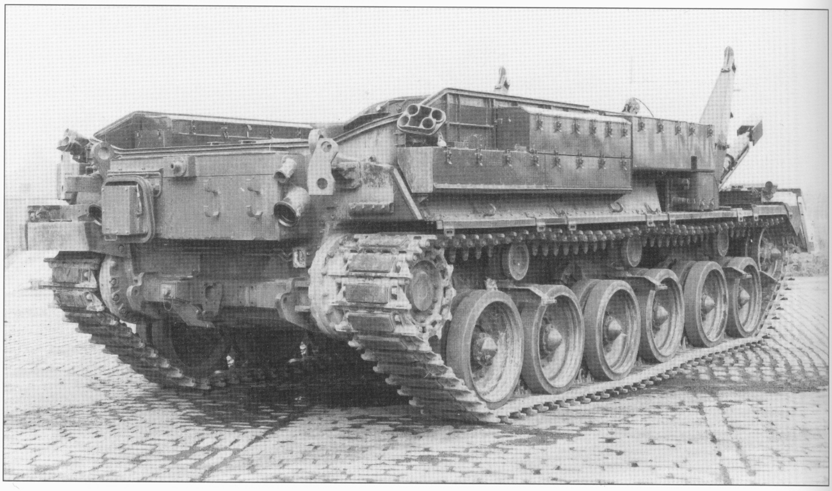
Mark 6/L Mark 6 with fitting of 'L' kit for Tank Laser Sight 'C' or No. 1 Mark 1.

Mark 6/1 Mark 6 with TLS No. 1 Mark 2 or No. 3 Mark 1 and Stage 1 MRS.

Mark 6/2 Mark 6 on completion of TLS No. 1 Mark 2 or No. 3 Mark 1 and MRS installation and removal of ranging gun and associated equipment.

Mark 6/3 Mark 6 on completion of TLS, MRS and Improved fire Control System (IFCS) and Simfics. Modifications to commander's cupola AVII vision sight L5A1; removal of meteorological system; conversion of TLS No. 1 Mark 2 and No. 3 Mark 1 to No. 2 Mark 2; conversion of FVGCE No. 7 Mark 4 to No. 10 Mark 1.

Mark 6/4 Mark 6 with modifications for stowage of Operational Emergency (OE) round or L23 APFSDS ammunition and revised sight graticule.



Mark 7
Mark 3, Mark 3/G, Mark 3/2 and Mark 3/S on completion of 'X', 'Y' and 'Z' programmes of 'Totem Pole' conversion.
Mark 7/L to 7/4 As for Mark 6/L to Mark 6/4.

Mark 8
Mark 3/3 on completion of 'X', 'Y' and 'Z' programmes of 'Totem Pole' conversion.
Mark 8/L to 8/4 As for Mark 6/L to Mark 6/4.

Mark 9
Mark 5/4, Mark 6/4, Mark 7/4 and Mark 8/4 on completion of full APFSDS ammunition stowage.

Mark 10
Mark 9 with Stillbrew passive armour and other survivability modifications including the No. 11 Mark 1 NBC pack.

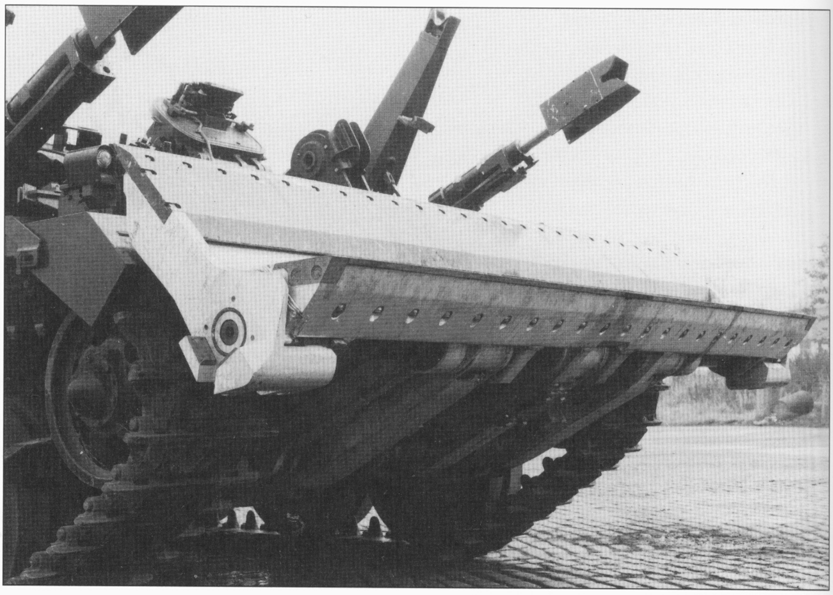
Mark 11
Mark 10 fitted with TOGS (Thermal Observation and Gunnery System). The Mark 11 was the final model in the British Army.

Mark 15
Manufacturer's designation of Chieftain model for Oman with final deliveries in 1985 when the Chieftain production line closed.

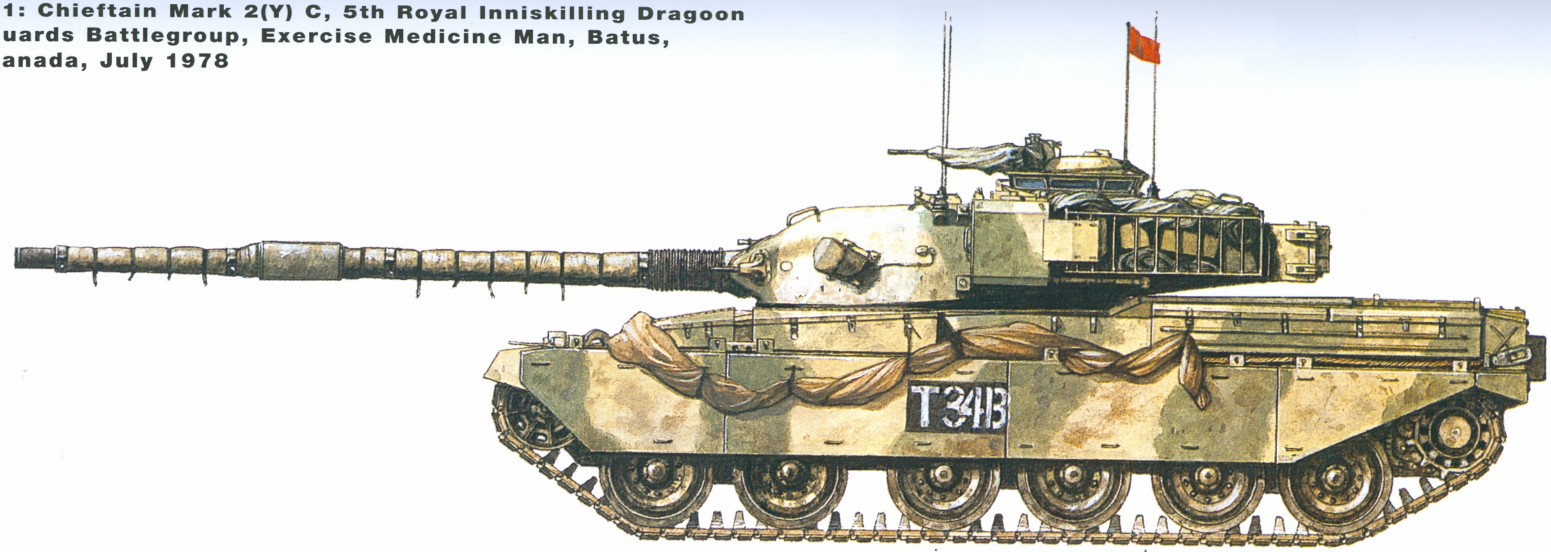
ABOVE AND BELOW **As the replacement for the Centurion Armoured Vehicle Royal Engineers or AVRE, two versions of a Chieftain special purpose variant designated Armoured Engineer Vehicle or AEV were developed. Due to financial constraints, only two prototypes of the AEV Winch were built before the project was cancelled in favour of the Combat Engineer Tractor. Similar in configuration to the Chieftain Mark 5 ARV, the AEV Winch featured a highly sophisticated dozer blade designed to undertake a range of earthmoving tasks.**

FV4202
Experimental model to test Chieftain concepts based on Centurion components and known as the '40-ton Centurion'. Three models built in 1956 by Leyland Motors.

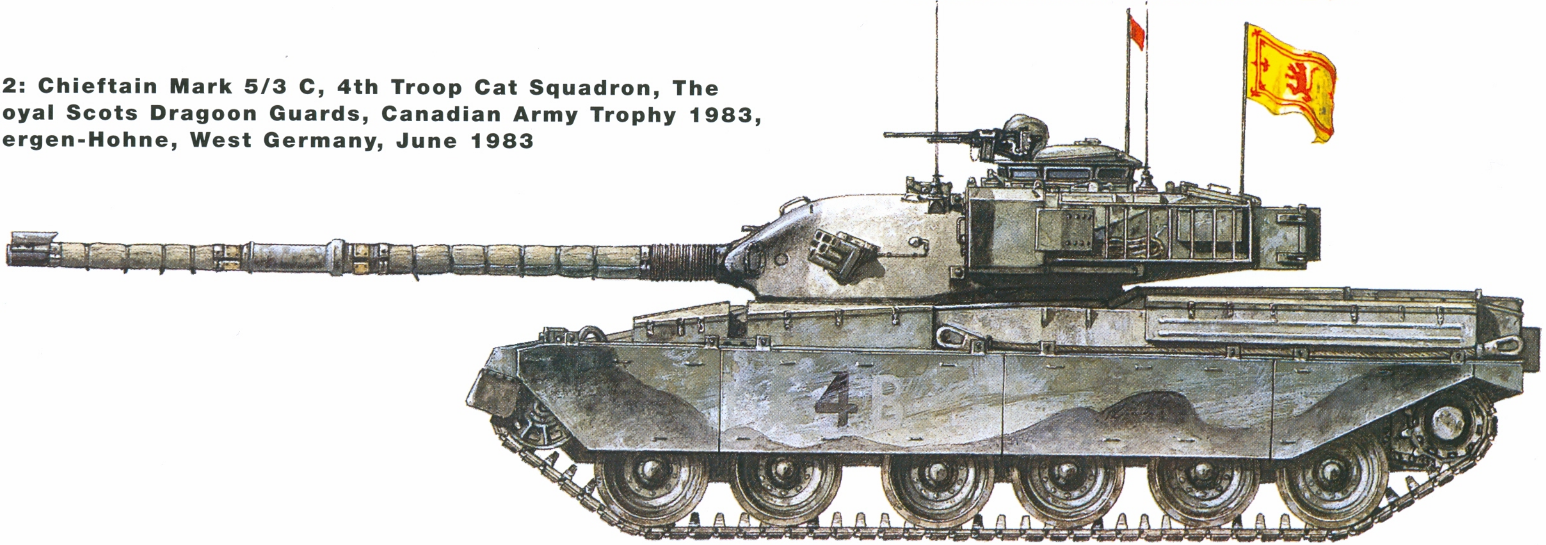
FV4203 AVRE
Intended replacement for the Centurion AVRE (Armoured Vehicle Royal Engineers) with two versions of Armoured Engineer Vehicle (AEV) – AEV Gun and AEV Winch. AEV with demolition gun cancelled due to financial constraints so



A1: Chieftain Mark 2(Y) C, 5th Royal Inniskilling Dragoon Guards Battlegroup, Exercise Medicine Man, Batus, Canada, July 1978

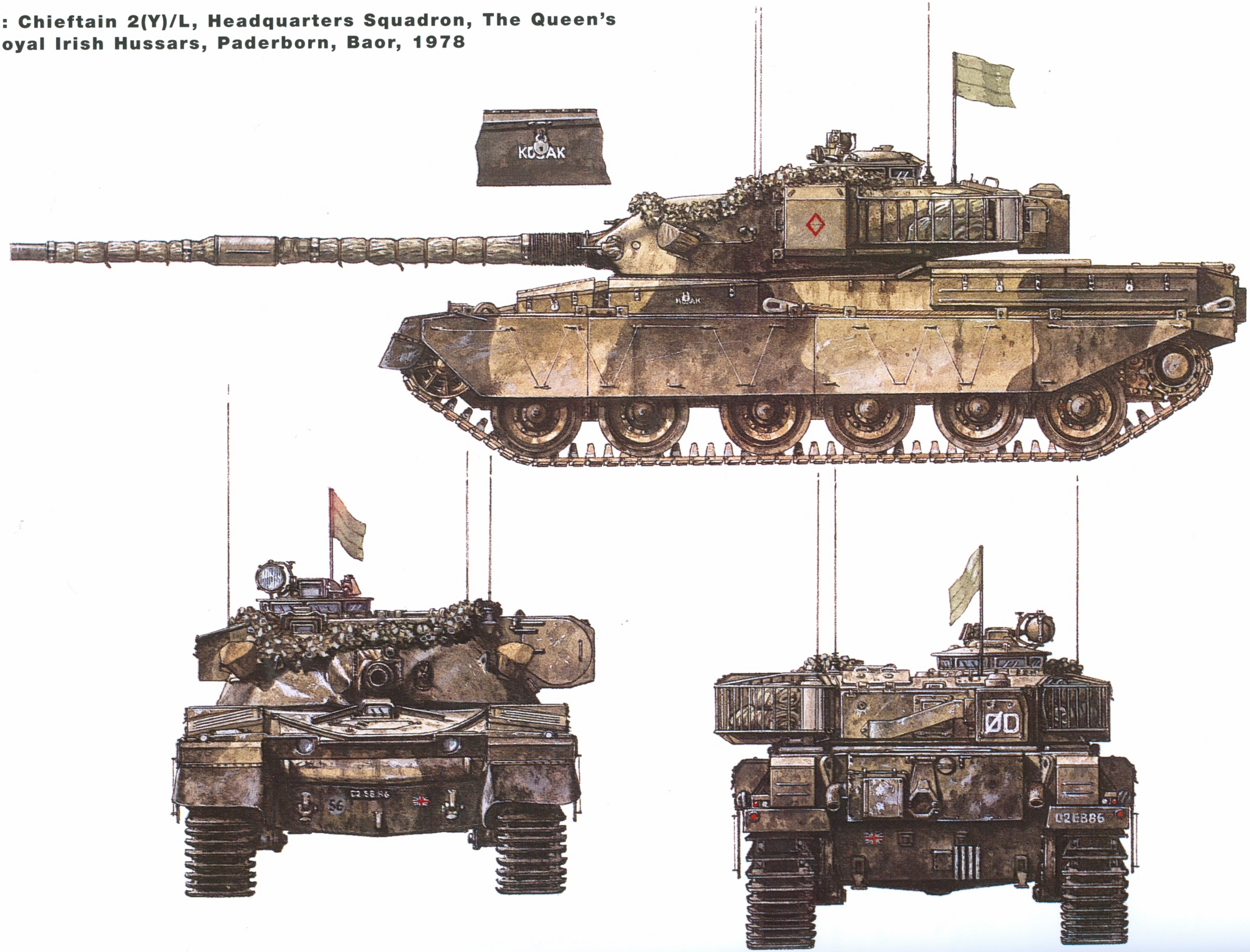


A2: Chieftain Mark 5/3 C, 4th Troop Cat Squadron, The Royal Scots Dragoon Guards, Canadian Army Trophy 1983, Bergen-Hohne, West Germany, June 1983

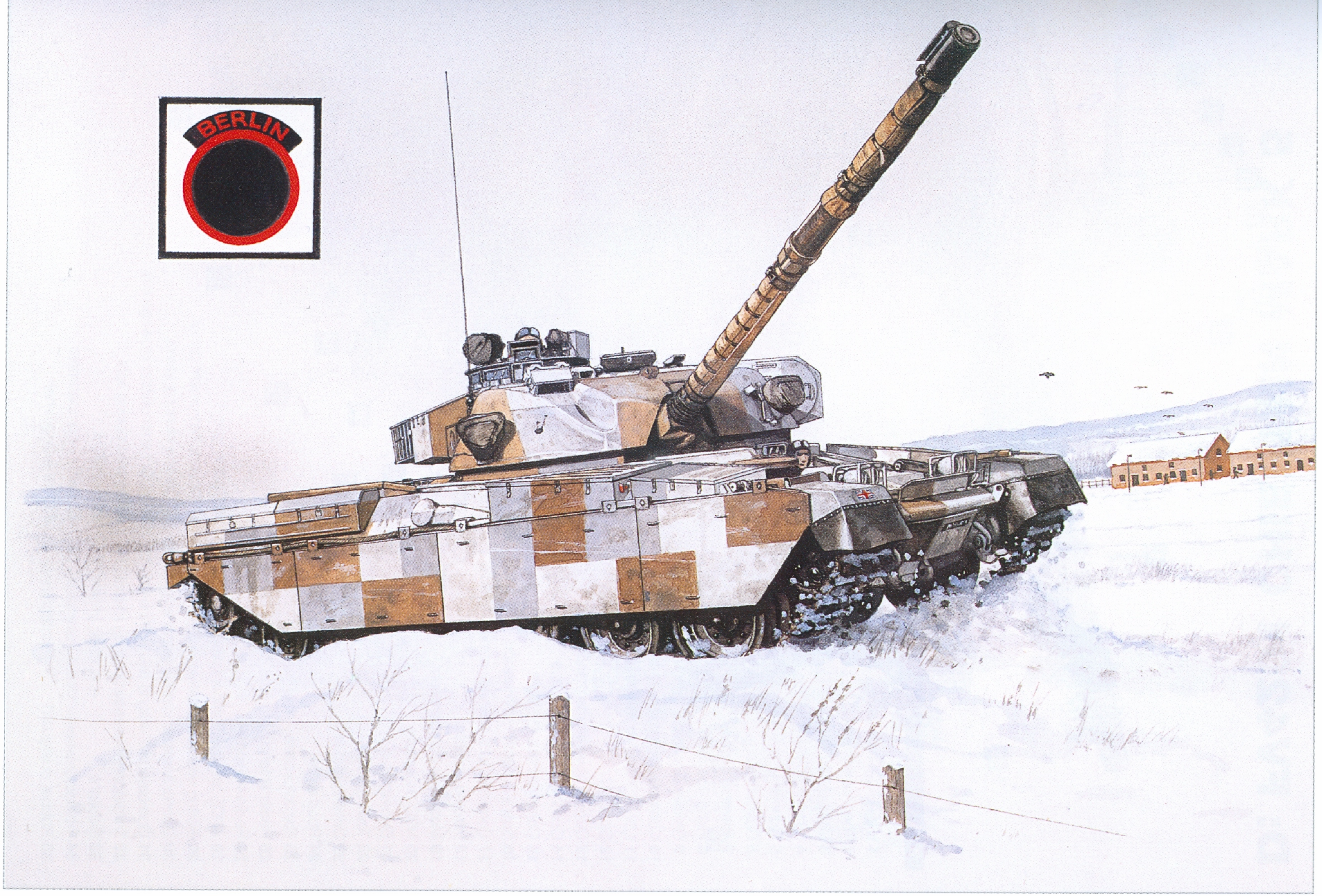


A

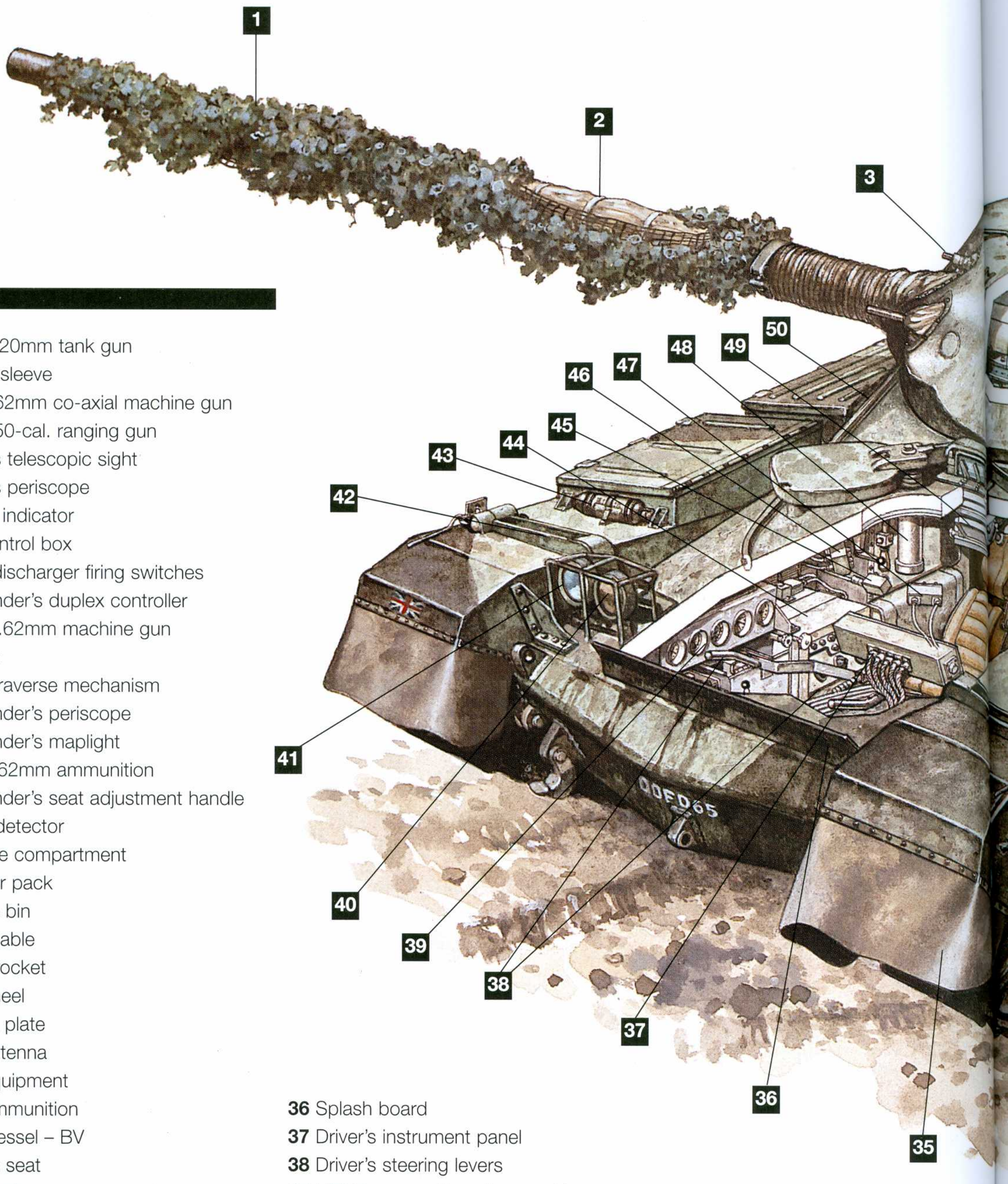
B: Chieftain 2(Y)/L, Headquarters Squadron, The Queen's Royal Irish Hussars, Paderborn, Baor, 1978


KODAK
KODAK
02EB86
56
0D
02EB86

C: Chieftain Mark 10 C, Armoured Squadron, Berlin Brigade, 1980s

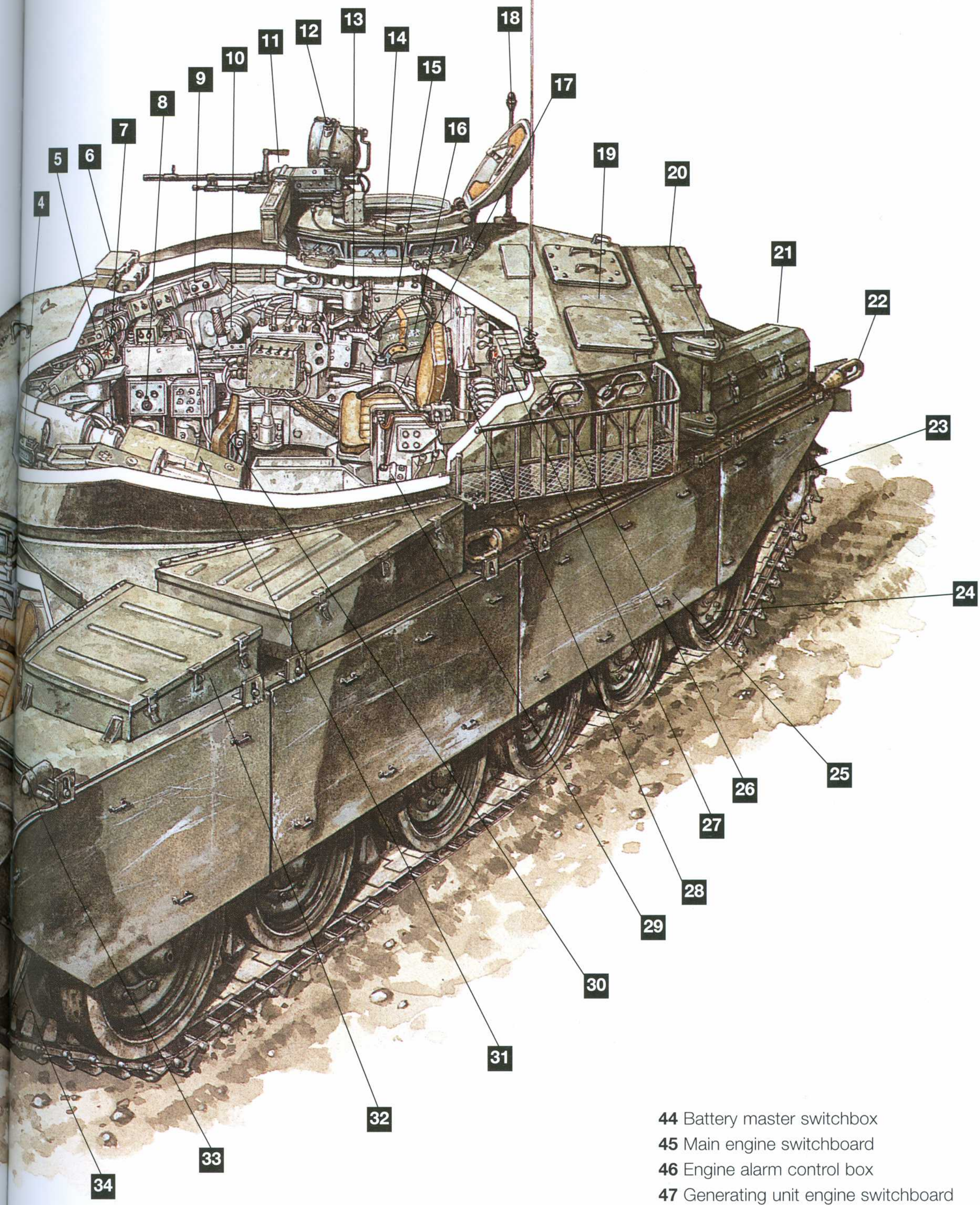


D: FV4201 CHIEFTAIN MARK 5



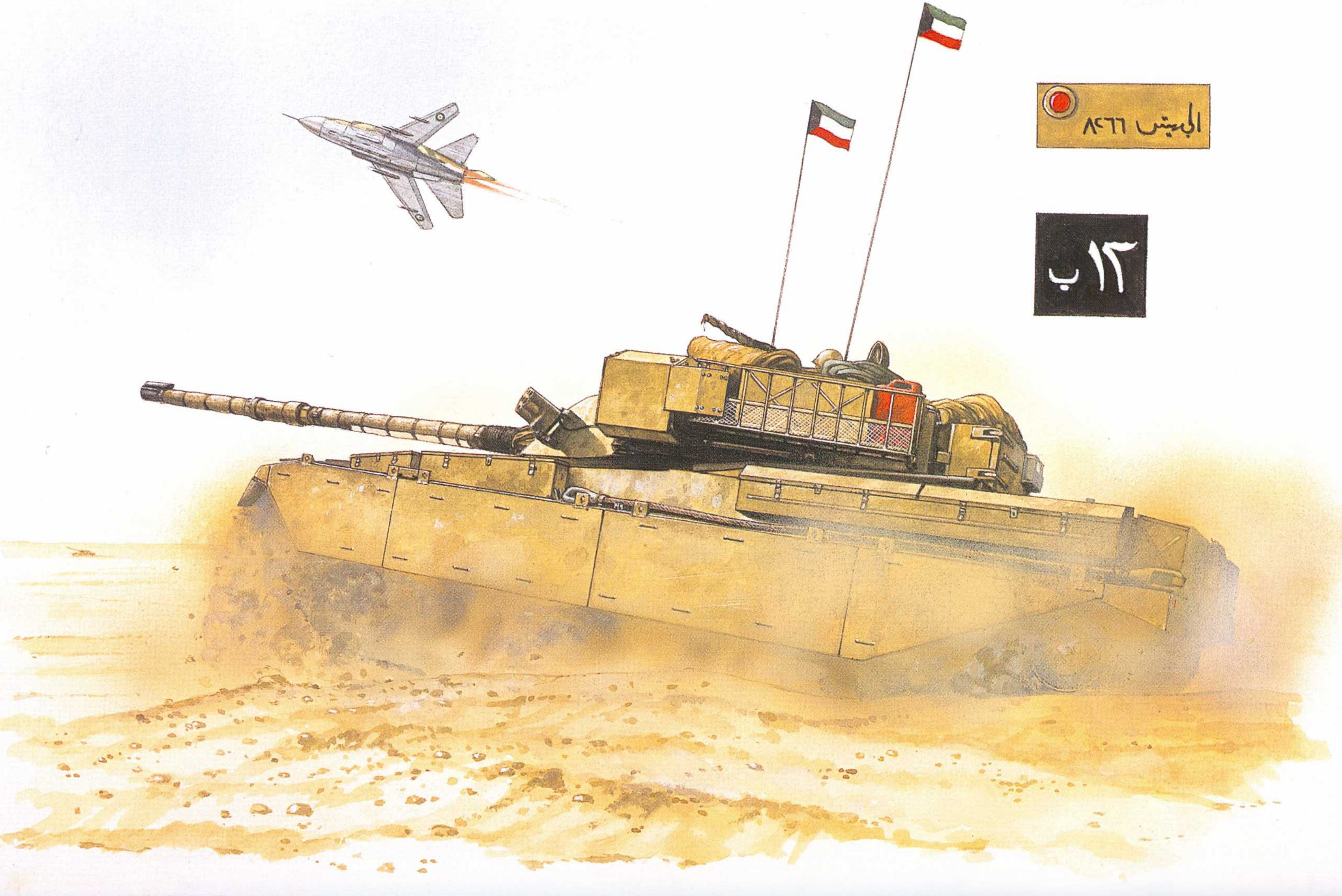
KEY

1 L11A3 120mm tank gun
2 Thermal sleeve
3 L8A1 7.62mm co-axial machine gun
4 L21A1 .50-cal. ranging gun
5 Gunner's telescopic sight
6 Gunner's periscope
7 Traverse indicator
8 Firing control box
9 Smoke discharger firing switches
10 Commander's duplex controller
11 L37A1 7.62mm machine gun
12 Spotlight
13 Cupola traverse mechanism
14 Commander's periscope
15 Commander's maplight
16 Spare 7.62mm ammunition
17 Commander's seat adjustment handle
18 Infrared detector
19 Metadyne compartment
20 NBC filter pack
21 Stowage bin
22 Towing cable
23 Drive sprocket
24 Road wheel
25 Bazooka plate
26 Radio antenna
27 Radio equipment
28 APDS ammunition
29 Boiling vessel – BV
30 Gunner's seat
31 Gun breech
32 Trackguard stowage bin
33 Sidelight
34 Front idler wheel
35 Rubber dustguard
36 Splash board
37 Driver's instrument panel
38 Driver's steering levers
39 HESH ammunition stowage bin
40 Infrared driving light
41 Headlight
42 Battery compartment
43 Fire extinguisher

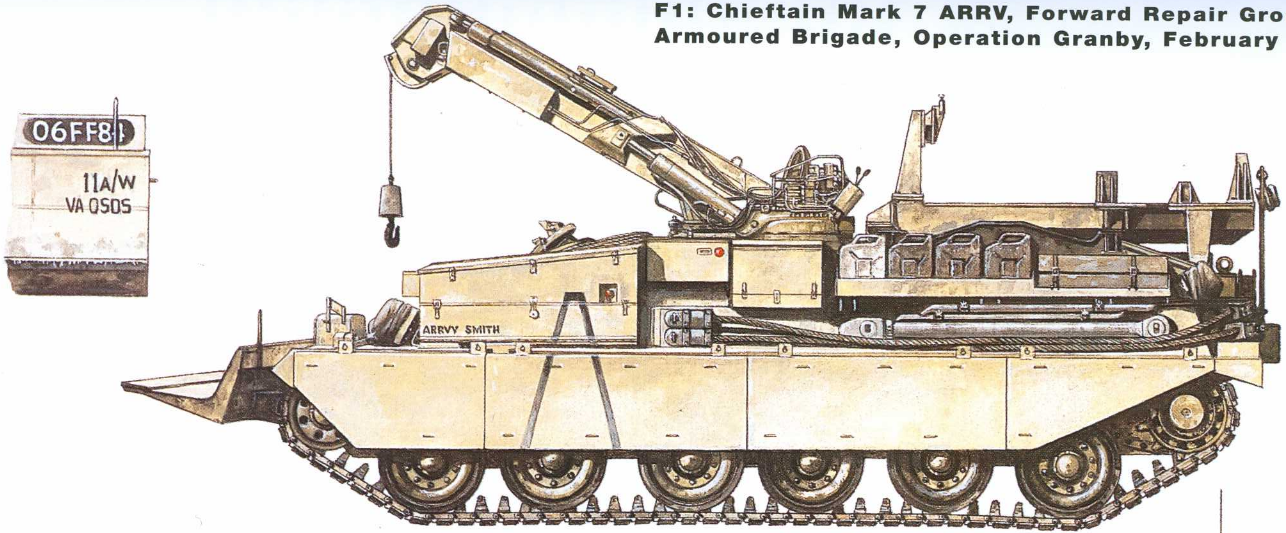

4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34

44 Battery master switchbox
45 Main engine switchboard
46 Engine alarm control box
47 Generating unit engine switchboard
48 Driver's access hatch spring tube
49 Driver's periscope
50 Attachment rail for deep wading equipment

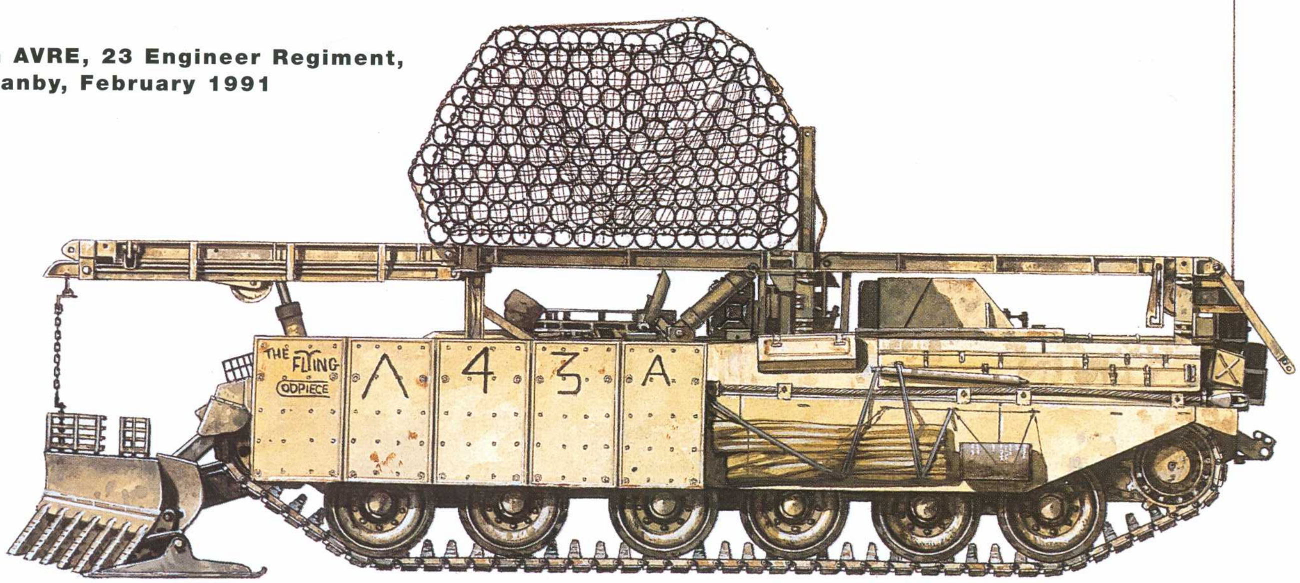
E: Chieftain Mark 5/2K, 38th Armoured Brigade, Kuwaiti Army, Saudi Arabia, August 1990


الجيش ٨٤٦٦
١٢ ب

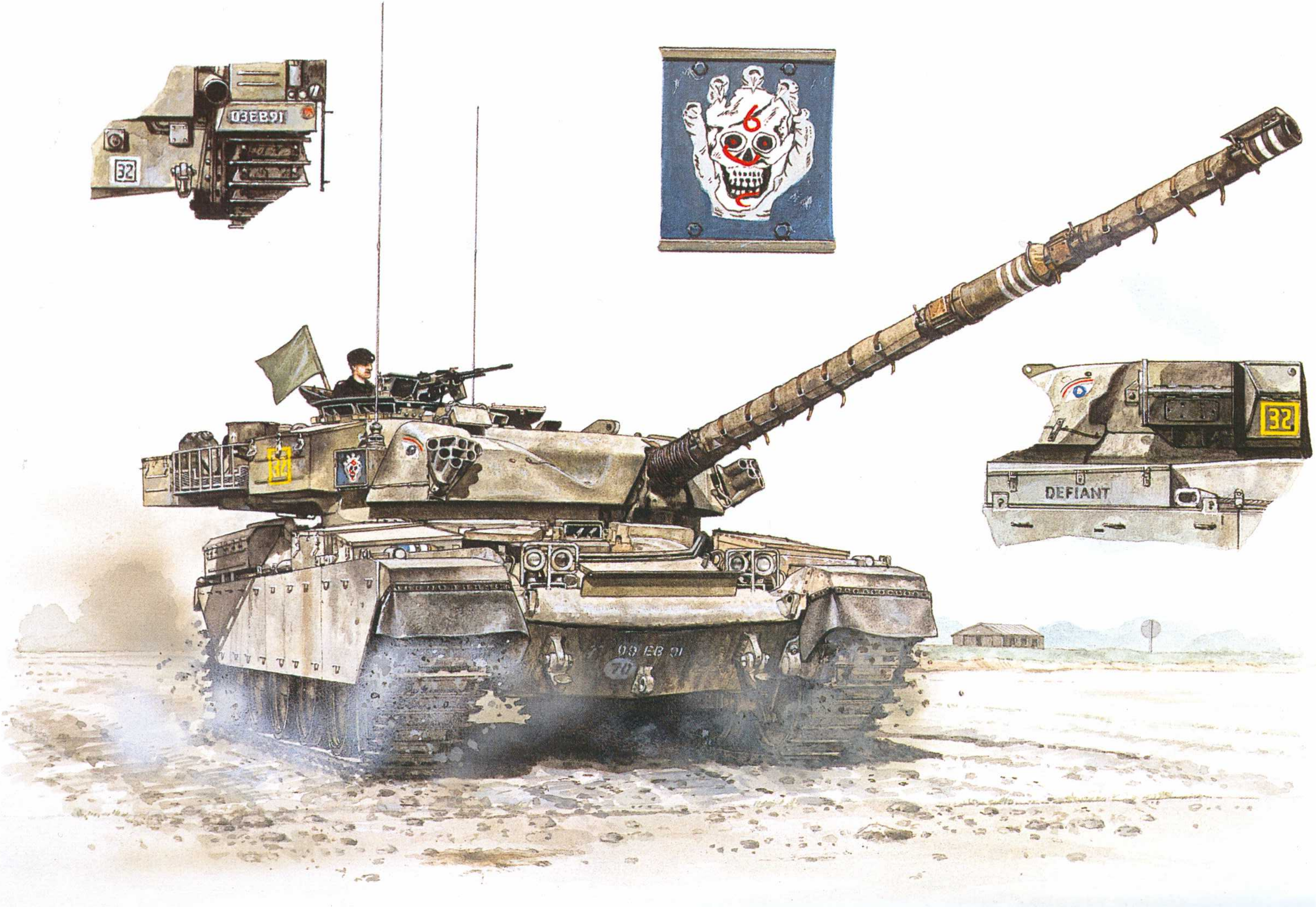
F1: Chieftain Mark 7 ARRV, Forward Repair Group, 4th Armoured Brigade, Operation Granby, February 1991

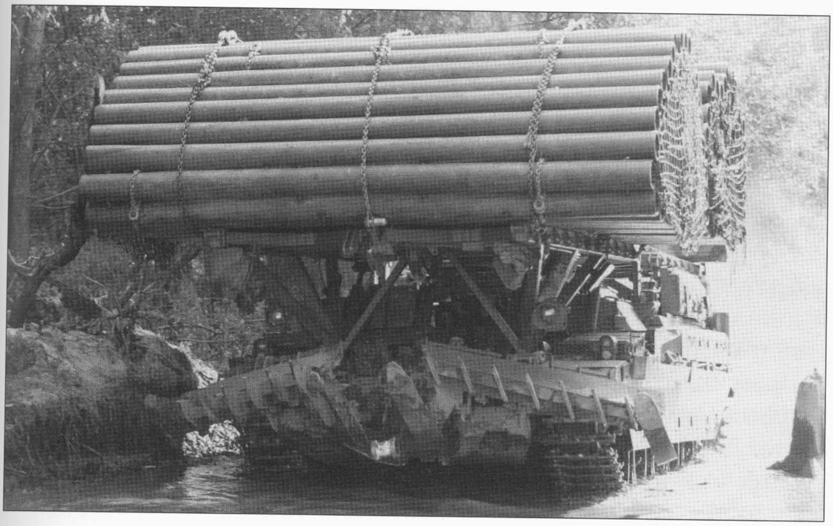

06FF8
11A/W
VA QSOS
ARRVY SMITH

F2: Chieftain AVRE, 23 Engineer Regiment, Operation Granby, February 1991


THE FLYING CODPIECE
Λ 4 3 A

G: Chieftain Mark 11 C, B Squadron 1st Royal Tank Regiment, Castlemartin Gunnery Ranges, South Wales, May 1995


03EB91
32
6
32
03 EB 91
70
32
DEFIANT



A CHAVRE of the 2nd Royal Tank Regiment Battlegroup negotiates a waterway during Exercise Uhlan Eagle '96 in Poland. The driver is positioned centrally, as in the Chieftain MBT, while, just behind him, the commander is visible in the armoured crew compartment. Up to five sappers can be housed under armour with the benefit of collective NBC protection. This vehicle shows the Pearson Engineering full-width mineplough to effect and its load of two Maxi-Pipe fascines. These are made up of standard commercial PVC waterpipes. Though many of the individual pipes are crushed or split after vehicle crossings, they are cheap to replace. The ends of the fascines are covered with netting to prevent the pipes becoming clogged with debris when dropped into streams or rivers.

AEV Winch developed further to become the FV4203 AVRE. Two prototypes built at ROF Leeds in late 1970 and early 1971. The Chieftain AVRE was similar in shape to the Chieftain ARV but had a dozer blade of much enhanced capability. The vehicle had a 30-tonne winch and 3-tonne auxiliary winch similar to the ARV that could be used to launch a 25-ft one-piece bridge carried on top of the hull. The project was cancelled in favour of the Combat Engineer Tractor but the concept was resurrected as the CHAVRE.

FV4204 ARV

Replacement for Centurion ARV. Two prototypes built at ROF Leeds in late 1970 and early 1971. Based on the Chieftain Mark 5 hull, production of Chieftain ARV undertaken by Vickers with first deliveries in 1975.

FV4205 AVLB

Chieftain AVLB (Armoured Vehicle Launched Bridge) replacement for Centurion Bridgelayer and Centurion ARK. Based on a standard Chieftain hull, four trials vehicles were built by ROF Leeds with the first delivered in September 1967 with the hulls manufactured at ROF Leeds, the bridge launch mechanism at ROF Nottingham and the bridges by Vickers at Elswick. 51 built by ROF Leeds between early 1972 and November 1976, of which 14 were for Iran. First production vehicle delivered in July 1972. Chieftain AVLB entered service with the British Army in 1974.

The development of the L60 engine

The L60 engine was designed and developed by Leyland under the direction of FVRDE. The reason for the adoption of a two-stroke opposed piston engine was three-fold; first the NATO requirement for multi-fuel engines in tanks; second the excellent performance of the small-capacity Rootes opposed piston two-stroke engine in small trucks, and third the available base design of the Junkers Ju86P aircraft engine. By the late 1950s single cylinder prototype engines were running at Tilling-Stevens and at Leyland. The first complete engine ran in 1959 and, by 1965, 60 had been built for development; these were designated Marks 1 to 4.

The L60 engine went into production in January 1965 as the Mark 4A, and produced 585bhp. In November, with a new piston crown, the 650bhp Mark 4A2 appeared, followed in April 1969 by the Mark 5A with a modified piston and liner. A de-rated version was produced for the Vickers Mark 1 Vijayanta for the Indian Army, producing 540bhp.

In October 1970 the low-loss two-stage air cleaner was introduced with the Mark 6A engine. Prior to 1971 engine development had been designated Fleetfoot, and the object had been to produce a reliable 750bhp. These engines were introduced in October 1971 as the Mark 7A for British Army use, and 8A for sales vehicles. The 7A engine produced 720bhp with the three-lobe scavenge blower, and the 8A engine produced 750bhp with the two-lobe scavenge blower. There was still difficulty in achieving reliability and the Dark Morn programme was introduced to improve the cylinder liner lip seal. At the same time liner strength was to be improved.

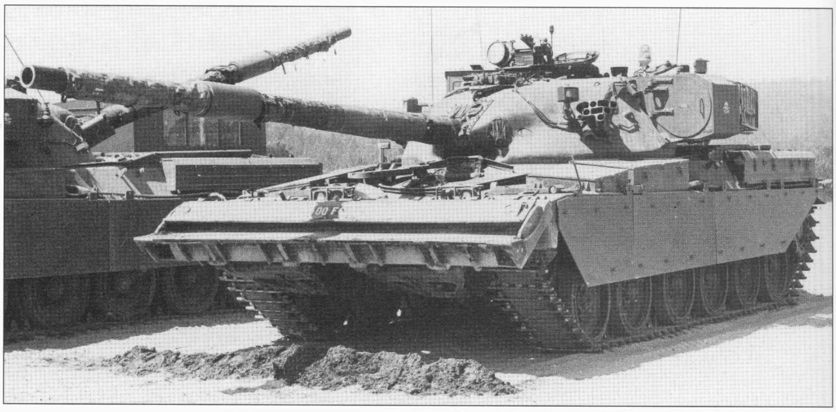
Under the High Noon programme, the liner was supported on rubber rings and was manufactured from Cast Iron (CI) 16 impregnated with silicon carbide. There were also piston, ring, and fan drive changes, including the introduction of Polyvee belts. From the Dark Morn programme came the 9A engine for British army use, and the 10A engine for sales vehicles.

Many failures were found to be due to abrasion of the liner O rings and a revised programme, called Exercise Sundance was introduced, with interference-fitted liners retaining the O ring. These materialised in March 1978 as the 11A and 12A engines. Also incorporated were the proven piston and piston ring modifications, Polyvee belts, CAV fuel filters and new injectors. Sundance Phase II started in October/November 1976, Phase IIa in April 1977, Phase IIIa ran between July and September 1977 and Phase V (No O ring) January 1979. A report dated November 1978 noted that the tight fit cylinder liner increased reliability, and 4,000-mile engine life was achieved by December 1978. During the Sundance programme some liners had been tested with no O-ring, but using a sealant adhesive (known as the No O-ring Tight Liner). In August 1979 these became the 11A/N and 12A/N engines - changed in April 1980 to the 13A and 14A engines.

The Mark 4A1 Engine Liners were of CI 16, with 10 swirl air ports, and 8 exhaust ports. They were honed in situ. The piston had a shallow crown, and was retained by long welded bolts. Molybdenum faced fire rings were fitted, with two stepped oil control rings. In April 1965 this engine reverted to the off-set combustion chamber. Injection timing was 16 degrees before exhaust TDC. There was a single exhaust box on each side. Sliding joints were provided in the exhaust system. A Vokes two-stage air cleaner was fitted, feeding the three-lobe blower, which was driven via a Metalastic drive coupling. A gauze screen was placed over the sump.

The Mark 4A2 Engine The piston incorporated an oil cell with a 35 per cent ni-iron crown. The offset combustion chamber was retained. In October 1967, a slotted oil control ring was introduced and the tin-plating on the piston crown was increased in thickness.

The Mark 5A Engine Liners were of CI 4. A re-designed



All Chieftain MBTs can be fitted with a dozer blade within six hours. Designed by Automotive Products limited, the electro-hydraulic power unit for the dozer blade is installed in place of the right-hand-front track stowage bin. A joystick unit in the driver's compartment controls the dozer blade and it has an earthmoving capacity equivalent to that of a medium bulldozer such as the Caterpillar D5. Its main tasks are the clearing or filling of obstacles on the battlefield such as anti-tank ditches and digging hull-down tank scrapes for fire positions. This Chieftain Mark 3/3 of the 17th/21st Lancers has its dozer blade in the travelling position. Tank dozers were normally issued on a scale of one per squadron but the Combat Engineer Tractor subsequently assumed the role and they were discontinued.

piston incorporated an oil cell with a shroud above the fire ring. The bowl was offset. A new sump was provided and fan hubs were pressure lubricated.

The Mark 6A Engine The two-stage low-loss air cleaner was retained and the piston crown set screws were brazed.

The Mark 7A Engine A new cylinder block was introduced with re-positioned port belt deflectors. The redesigned liner had 9 air ports and 10 exhaust ports. The connecting rod clearance slots were reduced at the air end. The piston featured a central bowl and the crown screws were locked by Helicoil. Injection timing was 18 degrees, reverting to 16 degrees before exhaust TDC. The exhaust flanges were now bolted. A twin-bodied heat exchanger was introduced, together with new radiators. There were changes to the fan speed and blade settings. In June 1972, Casco MLF replaced Wellseal. In July 1972 Belzona was used behind the liner seals.

The Mark 8A Engine Liners were of CI 4 and were shot-peened. A stick cast piston crown was employed, together with a two lobe scavenge blower.

Mark 4A/5A/6A/7A/7ATPS/9A Engines In June 1977 CI 16 liners were introduced. Cylinder bores were treated with silicon carbide. Belzona was used behind lands 4/5. The stick cast crown was provided with improved oil cooling. The CI 16 fire rings incorporated in-springing. CI 4 wedge-shaped compression rings were employed.

The Mark 10A Engine This was a sales engine. It employed the two lobe scavenge blower and other improvements as outlined above.

The Mark 11A Engine CI 16 Tight Fit O Ring Liners were fitted in re-bored Mark 7A cylinder blocks. Mark 10A pistons were fitted, with increased skirt clearance. The three lobe scavenge blower was fitted, as were Polyvee belts.

The Mark 11A/N Engine CI 16 No O Ring Tight Liners were fitted in re-bored Mark 7A cylinder blocks. Permabond A150 sealing was employed. The remainder as was for the Mark 11A engine.

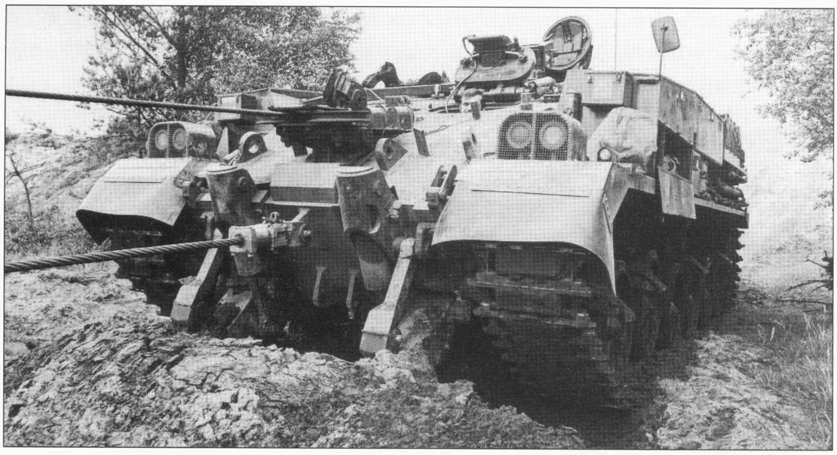
The Mark 12A Engine This engine was as for the Mark 11A, but with the two-lobed blower.

The Mark 12A/N Engine This engine was as for the Mark 11A/N, but with the two-lobed blower.

The Mark 13A Engine This engine was the re-named Mark 11A/N engine, from April 1980.

The Mark 14A Engine This engine was the re-named Mark 12A/N engine, from April 1980.

Trials were also carried out with ceramic and compounded graphite piston crowns. The longer engine life following the Sundance programme highlighted further weak areas in the engine, which had escaped notice before. The most serious was oil starvation at the upper crankshaft when the engine was cold, resulting in a requirement to crank the engine (on the hydraulic starter) for between 20 and 30 seconds before starting. Non-return valves fitted within the block in order to reduce this problem did not appear to provide a solution. Eventually, the L60 engine proved to be a satisfactory powerplant but crew confidence in its reliability was never of the highest. It continues in service to this day in the Chieftain special purpose variants employed by the Royal Engineers.

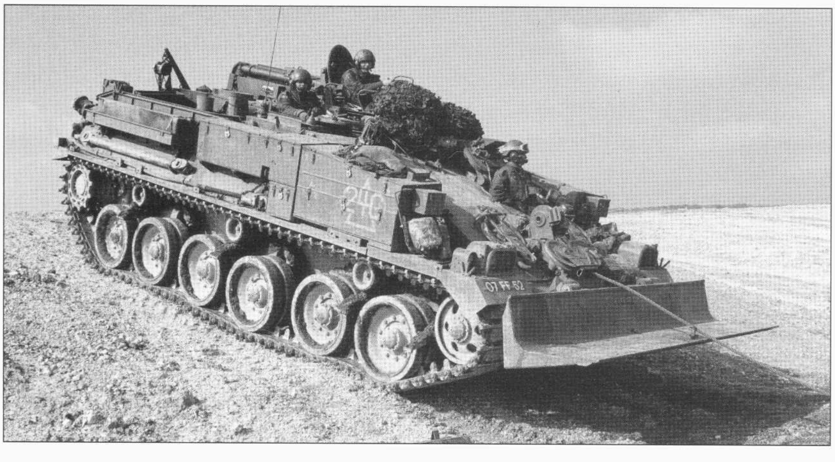


With its dozer blade deeply embedded as an earth anchor, a Chieftain Mark 5 ARV is put through its paces on Bordon Heath during recovery training of REME craftsmen. The ARV is fitted with a front-mounted, double-capstan winch with electro-hydraulic controls and is provided with 122m of 28mm diameter cable. An auxiliary winch is also hydraulically operated and provided with 260m of 11mm diameter cable, which is used for light recoveries and to pay out the main winch cable – an exhausting task if done by hand as was necessary with the Centurion ARV. Power for both winches is taken from a power-take-off on the main engine. To stabilise the ARV during recovery operations, the vehicle is fitted with an earth anchor, which allows the vehicle to pull up to 90,000kg. It also doubles as a dozer blade for site clearance and earth-moving tasks.

Totem Pole

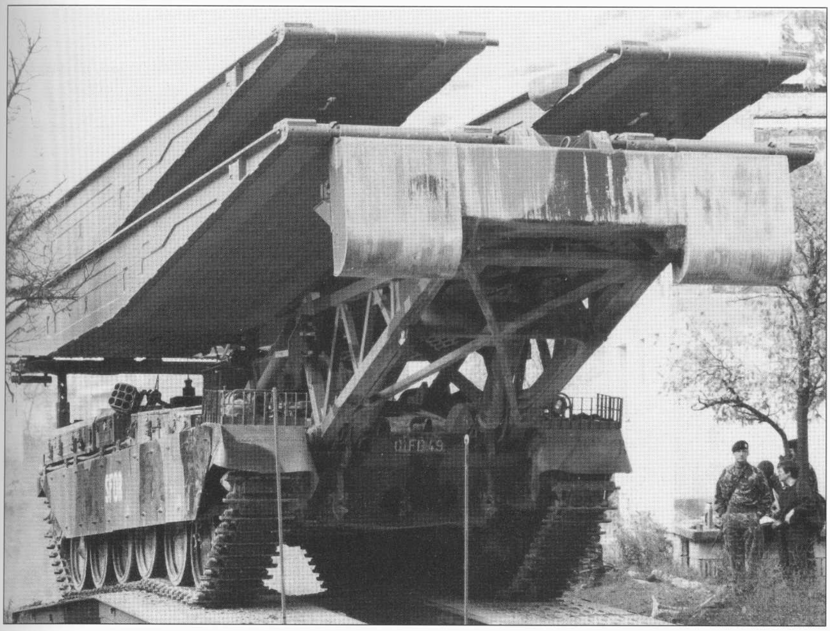
The 'Totem Pole' conversion programme was undertaken to upgrade earlier Chieftain marks to a similar fire control system and automotive standard as the Mark 5 with the later 750bhp L60 Mark 8A engine which was produced from mid-1975. It was divided into three aspects with 'X' mainly concerned with the fire control system and 'Y' and 'Z' related to automotive improvements. Originally the X, Y and Z Programmes were intended to be undertaken by Unit, Field and Base Workshops but this proved impractical because of insufficient manpower at field level so special 'Field' lines were set up at Base and UK Command Workshops.

The X Programme was instituted to make the sighting system compatible with the extended ranging gun ammunition by modifying the gunner's day sight and telescope as well as the commander's collimator with new graticules. Certain other improvements were made to the sight mountings and coupling links. The Y Programme introduced numerous modifications and improvements including: low-loss air cleaner for the L60, 12:1 ratio parking brake, commander's firing switch and engine cut-out, TLS sight mounting and modifications to the gunner's day and night sights, changes to sight stowage, and revised air cleaner system for GUE. The Z Programme was originally intended to be undertaken during base workshop overhaul and mainly involved modifications to enhance the reliability of the L60 engine and regularise the build standard throughout



With a crew of four, the Chieftain ARV had a fully loaded weight of 54.7 tonnes (56,000kg) and the armament comprised a cupola-mounted 7.62mm L37A1 machine gun and smoke grenade dischargers. Two Chieftain ARVs manned by REME crews supported each armoured squadron within the Royal Armoured Corps. This example is a later Chieftain Mark 7 ARRV or Armoured Repair and Recovery Vehicle, attached to A Squadron, The Royal Scots Dragoon Guards, during Exercise Phantom Bugle on the Salisbury Plain Training Area in 1995. The ARRV featured an Atlas crane with a lifting capability of 6.5 tonnes at 3.2m radius so it was able to remove the complete powerpack of Challenger 1, which weighed 5.5 tonnes.

the Chieftain fleet, but it also included improvements such as oil-filled running gear assemblies, better Metadyne cooling, fitting of the No. 6 Mark 2 NBC pack, and new type gun clamp. The programme was extended to incorporate other important improvements such as power supply boxes for crew heated clothing and fittings for the Clansman range of radio equipment. When fitted with Clansman radios, all marks of Chieftain MBT, from the Mark 2 onwards, were given the suffix C.


The BR90 Close Support Bridging System comprises three different types of tank-launched bridges capable of spanning gaps from 12m to 24.5m or more by combination bridging. This Stabilisation Force (SFOR) Chieftain Mark 5 AVLB in Bosnia is carrying two No. 12 Tank Bridges, which can be launched independently. Other bridges are carried by the Tank Bridge Transporter based on the Alvis Unipower 8 x 8 chassis.

CHIEFTAIN SPECIAL PURPOSE VARIANTS

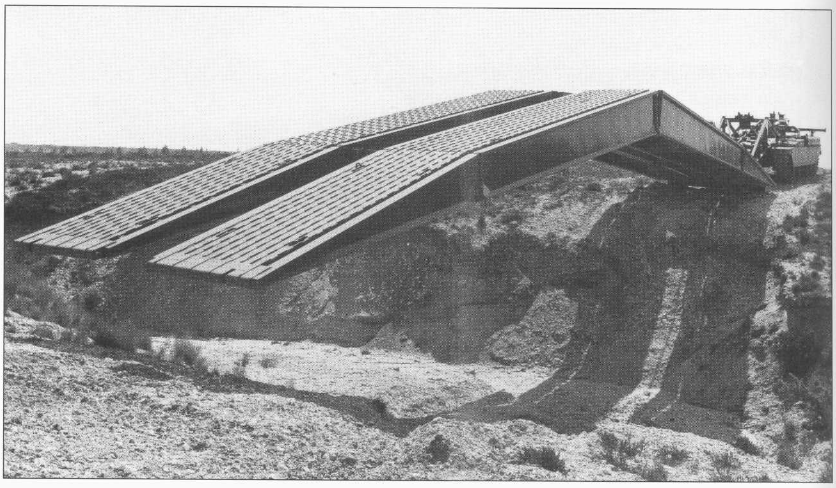
FV4204 Chieftain Armoured Recovery Vehicle

The introduction into service of a new MBT invariably heralds the development of a number of special purpose variants based on the hull of the tank to allow comparable performance on the battlefield and to achieve commonality of fuel and spares support. When the Chieftain MBT entered service from 1967 onwards, a family of special purpose variants based on the Centurion initially supported it. Although they proved adequate for the task, the Centurion was powered by petrol and did not have the road speed of Chieftain, which used diesel.

Of all the special purpose variants of a tank, the Armoured Recovery Vehicle or ARV is the most important. Its principal task is to recover bogged or damaged MBTs on the battlefield and provide front-line servicing and repairs to broken down tanks.

The Centurion ARV had been in service with the Royal Electrical and Mechanical Engineers (REME) since 1955 and, although rugged and reliable, had several limitations, not least of which was its inability to recover a tank from the front with the crew protected under armour. This deficiency was overcome in the design of the Chieftain ARV that was endorsed by the General Staff in November 1964. The requirement also stated that the ARV should act as a ‘pathfinder’ vehicle during water crossing operations so it was to have a deep wading capability. Project studies were initiated and full development followed within REME and at ROF Leeds.

Automotively, the ARV was identical to the Chieftain Mark 5 MBT. Similar in configuration to the Conqueror ARV, it featured an armoured hull and superstructure housing the crew, and a 30-ton main capstan winch and a 3-ton auxiliary winch, both of which were located in the front

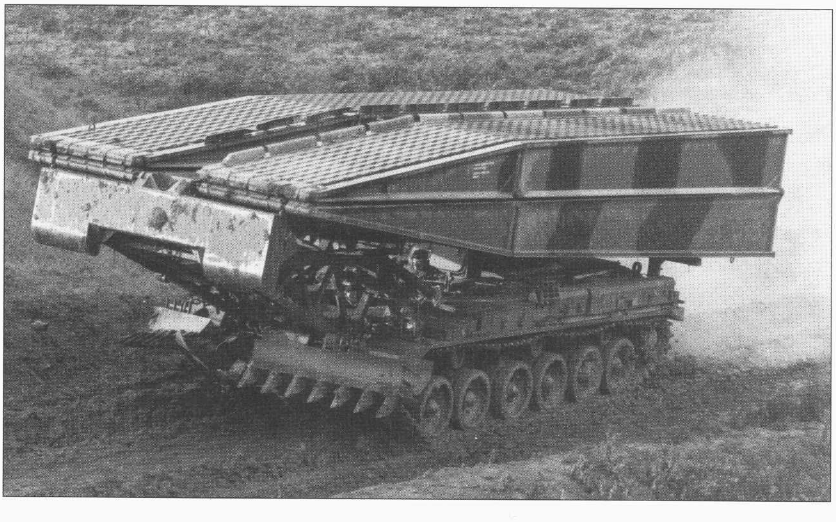


An FV4205 displays the great length of its No. 8 Tank Bridge during trials of the Chieftain Mark 5 AVLB in July 1970. At the time of its introduction, the No. 8 Tank Bridge was the longest of any AVLB in the world, capable of spanning gaps of up to 70ft, which is sufficient to negotiate more than 60 per cent of water obstacles in northwest Europe. The bridge can be laid in less than five minutes and recovered in ten from either end.

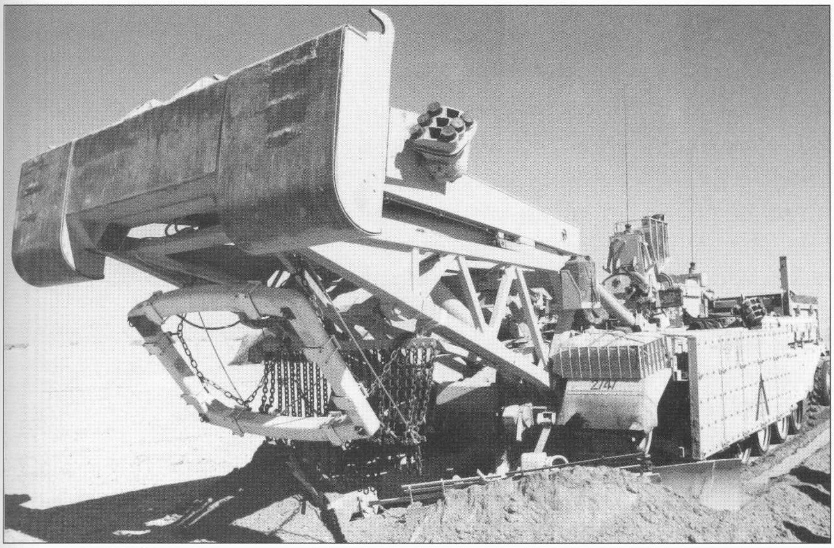
right-hand side of the vehicle. The main winch was mechanically driven, via a power take-off and propeller shaft, by the main engine. By means of block and tackle, the ARV was capable of exerting a 90-ton pull with the front dozer blade acting as an earth anchor; this was sufficient to recover any AFV in service. Such an arrangement allowed the crew and the winch, and therefore any recovery operation, to be carried out from under armour protection once the main cable had been attached to the casualty.

Four special purpose prototypes were built by ROF Leeds including two ARVs (R1 and R2) and two AVREs (E1 and E2), which were completed in early 1971. However, many serious problems were discovered during the initial manufacturer's trials leading to a complete redesign of the hydraulic controls system by Lockheed Precision Products. User trials of R1 were undertaken at SEME Bordon between September and December 1971. These revealed a fundamental weakness in the dozer blade/earth anchor, and a major failure of the main winch curtailed the trials prematurely. Meanwhile, Prototype R2 had been modified with the new hydraulic control system and it underwent trials at SEME during 1972. These comprised intensive testing of the vehicle with two shifts of REME craftsmen operating the ARV for seven days a week with night exercises and two 24-hour 'closed down' operations. During these trials, the cumulative winch usage achieved was more than twice that estimated as the maximum before base overhaul was necessary.

After various modifications and improvements, production was undertaken by Vickers at Elswick. In total, 257 ARVs were built at New-



A further batch of Chieftain bridgelayers was procured by the British Army in 1986. Designated Chieftain Mark 6 AVLB, 11 vehicles were produced by Vickers Defence Systems from Chieftain Mark 1/4 gun tanks that had been used for driver training in the UK. This Chieftain Mark 6 AVLB is carrying a No. 8 Tank Bridge and a front-mounted Pearson Engineering mineplough.



Virtually every CHAVRE and CHAVLB (see plate F2) was deployed during Operation Granby in the expectation that they would be required to breach the extensive Iraqi defensive fortifications along the borders of Kuwait. To this end, they were modified with supplementary armour protecting the crew compartment, comprising Chobham armour panels similar to those fitted to the Warrior IFV. By then both types of armoured engineering vehicles incorporated mineploughs, as shown here undergoing tests on a CHAVLB with its side-mounted Chobham armour panels, and a MIMIC – Magnetic Influence Mine Induction Coil – below the launching mechanism. This device was intended to detonate magnetic mines ahead of the vehicle. The CHAVLB also towed either an AVRE trailer carrying engineer stores or a Giant Viper trailer with its rocket-propelled explosive hose to clear a path through enemy minefields. Behind the MIMIC is a chain screen protecting the driver's compartment. This was intended to detonate anti-tank projectiles such as Rocket Propelled Grenades before they struck the AVLB's hull. These Chieftain variants were also used during Operation Telic in Iraq in March–April 2003.

castle upon Tyne, with the first deliveries to the British Army in 1974. Foreign users included Iran, which received 41 out of an order for 73, while Jordan procured further vehicles. This version featured an Atlas AK 6000M hydraulic crane with a maximum lift of 6.5 tonnes that allowed the ARV to replace major assemblies such as a power pack in the field.

Initially, the British Army employed the FV434 Fitters Vehicle for this purpose but the advantages of having an integral crane on the Chieftain ARV soon became apparent. It became vital when the Challenger 1 MBT entered service, as the FV434 Fitters Vehicle was incapable of lifting the Challenger power pack. Accordingly, British Chieftain ARVs were reworked to carry the same Atlas hydraulic crane. This model was designated the Chieftain Mark 7 Armoured Repair and Recovery Vehicle (ARRV) and later CHARRV to differentiate it from the Challenger ARRV or CRARRV. At one stage it was planned that the ARRV would carry a spare power pack on a cradle above the engine deck but this made the vehicle conspicuous when operating tactically in the field. Furthermore, it was incapable of passing under many road bridges. Instead, special trailers were built to carry the power packs, although the cradles were fitted to several ARRVs during the Gulf War of 1991 in the wide open stretches of the desert, where bridges did not pose a problem – see plate F. The Chieftain ARRV remained in service with the British Army well into the late 1990s when the Challenger ARRV superseded it.

FV4205 Chieftain Armoured Vehicle Launched Bridge (AVLB)

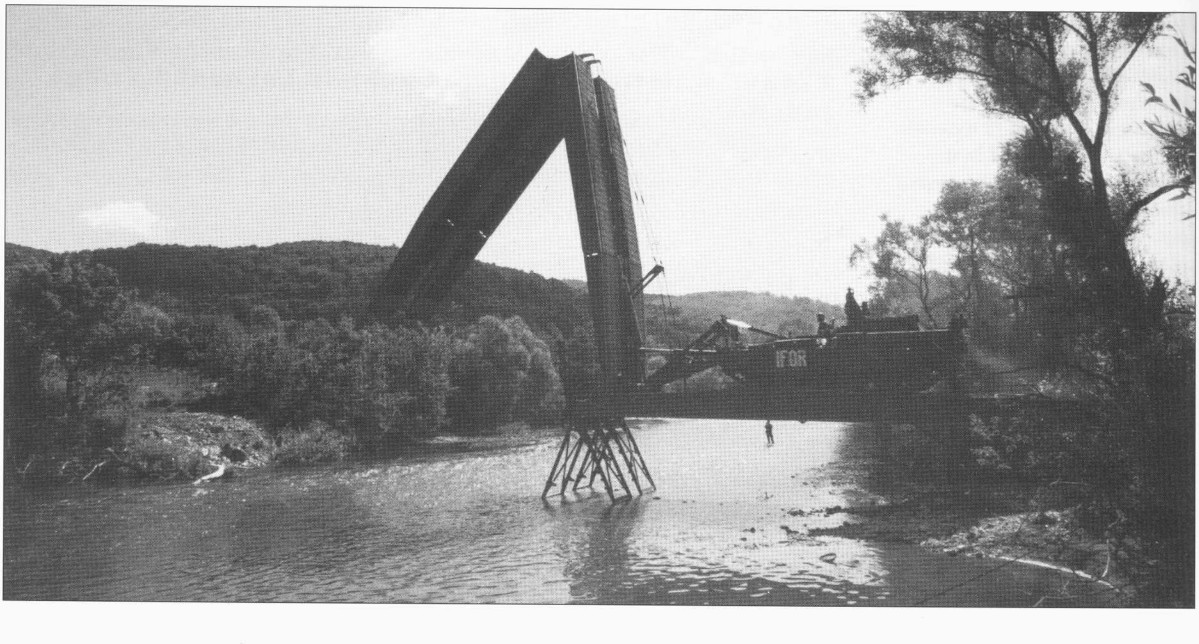
As a replacement for the Centurion Mark 5 Bridgelayer, a vehicle designated **Chieftain Mark 5 AVLB** (Armoured Vehicle Launched Bridge) was developed by MVEE (Military Vehicles and Engineering Establishment – the former FVRDE) and Lockheed Precision Products of Birmingham for the hydraulic lifting mechanism. Four prototypes were built at ROF Leeds with the first model being delivered in September 1967 for troop trials with the Royal Engineers. The launching mechanism was hydraulically operated and derived its power from a pump driven by the main engine. Three sets of rams launched the bridge vertically over the chassis with the launch sequence taking under three minutes with little or no bank preparation. The AVLB carried either of two bridges – a scissors type No. 8 Tank Bridge and a rigid No. 9 Tank Bridge. The No. 8 Tank Bridge had an overall length of 80ft (24.3m) capable of bridging a gap of 75ft (22.9m) – a far greater capability than any contemporary foreign bridgelayer. The No. 9 Tank Bridge was carried horizontally on the vehicle and swung vertically through 180 degrees to span a gap up to 40ft (12m). Both bridges were made of a zinc/aluminium/magnesium (ZAM) alloy and maraging steel for maximum strength and minimum weight. Each was capable of carrying AFVs up to a weight of 80 tons.

ROF Leeds undertook series production of 37 Chieftain Mark 5 AVLBs from 1972, with the first deliveries to the British Army in 1974. Three Sappers from the Armoured Engineer Regiments of the Royal Engineers manned each AVLB. The AVLB's role was to provide armoured engineering support by bridging waterways and anti-tank obstacles to maintain the advance of an armoured formation on the battlefield. It was normally deployed as part of a 'bridging train' with each AVLB having support vehicles carrying supplementary bridges, either No. 8 or 9, for maximum flexibility. All bridges were capable of being recovered from either end in less than ten minutes (in ideal conditions).

In March 1984 Vickers Defence Systems was awarded a contract to convert 11 Chieftain Mark 1/4 MBTs into the **Chieftain Mark 6 AVLB**. Employing the same launching system as the earlier AVLB, user trials were completed by November 1985 and the vehicles were delivered to the British Army between June and September 1986. These vehicles, as well as the earlier AVLB models, were equipped with fitments to mount a range of mineploughs and dozer blades to extend their flexibility in the armoured engineering role on the battlefield. During the Gulf War of 1991, equipment of this type was fitted to most of the Chieftain AVLBs, now designated CHAVLB, for use in the mine-clearing role as well as for bridging. Besides the Pearson Engineering mineplough system mounted at the front of the hull, they also carried a device known as MIMIC to detect and activate mines with magnetic fuses. All the CHAVLBs deployed for Operation Desert Sabre were fitted with Chobham armour panels along the sides of the crew compartment to increase survivability.

Following the Gulf War, the original No. 8 or No. 9 Tank Bridges carried by CHAVLB were replaced by the new Close Support Bridging

BELOW AND OPPOSITE **A Chieftain Mark 5 AVLB of the Implementation Force (IFOR) demonstrates the versatility of combination bridging near Sanski Most in Bosnia on 10 July 1996 using the new advanced aluminium alloy bridges of BR90. Having laid a No. 10 Tank Bridge with end trestle, the Chieftain Mark 5 AVLB is laying a second complete No. 10 Tank Bridge to span the river. By these means, gaps up to a nominal 60m span can be bridged at Military Load Classification of 70 tonnes (MLC70).**

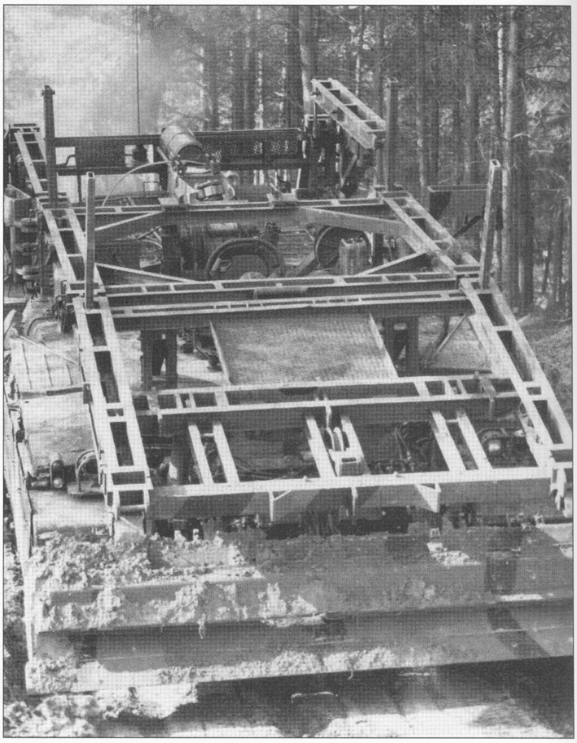


(CSB) system – part of the overall BR90 (Bridging for the Nineties) series developed for the British Army. The Close Support Bridge system consists of a set of three tank-launched bridges, a modification kit for the CHAVLB and a Tank Bridge Transporter truck based on the high-mobility Alvis Unipower 8 x 8 vehicle. All of these bridges take a maximum of three minutes to lay and five minutes to recover under ideal conditions, and comprise: the 26m long scissors-type No. 10 Tank Bridge that can span a gap of 24.5m; the 16m long No. 11 Tank Bridge of the up-and-over type, that can span a gap of 14.5m; and the 13.5m long No. 12 Tank Bridge, also of the up-and-over type, that can span a gap of 12m. The launching system allows two No. 12 Bridges to be carried at the same time. To increase flexibility, combination bridging is possible using two or three bridges with the far end supported on the bottom of the gap or on a trestle to allow obstacles of up to 5m deep and 60m wide to be spanned for vehicles weighing up to 70 tons. The CHAVLB is to be replaced later in this decade by a similar system based on the Challenger 2 chassis and known as Titan.

Chieftain Armoured Vehicle Royal Engineers (CHAVRE)

Two versions of a Chieftain AVRE designated Armoured Engineer Vehicle Gun and Armoured Engineer Vehicle Winch were originally developed to replace the venerable Centurion AVRE but the project was cancelled in 1971 in favour of the Combat Engineer Tractor. With the advent of Challenger 1 as the frontline MBT in BAOR, the Centurion AVRE was hard pushed to keep up with the other AFVs within the battlegroup. As more armoured regiments were equipped with Challenger 1, the redundant Chieftain MBTs became available for other purposes. The Royal Engineers Wing at Bovington addressed the problem and suggested that a Chieftain stripped of its 12-ton gun turret would have greater battlefield mobility and speed than the Centurion AVRE, even when fitted with a range of engineer stores. The primary roles of the new AVRE were mine clearance, with a combination of mine-plough and Giant Viper, and the carriage of Class 60 Trackway or Maxi-Pipe fascines to negotiate various obstacles on the battlefield. The Centurion AVRE was only capable of carrying either a single roll of trackway or one fascine, which was woefully inadequate. A vehicle able to carry either three fascines or six rolls of trackway was required with the ability to deploy them from under armour without exposure of the crew to hostile fire.

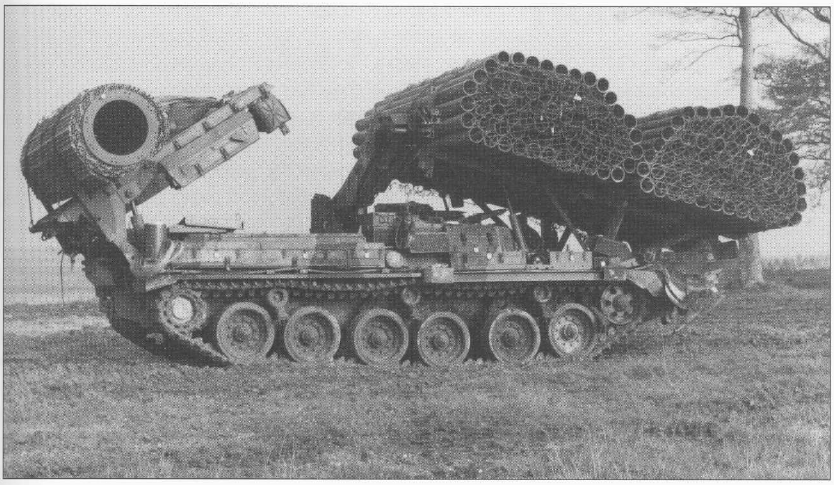
Working in conjunction with 32 Armoured Engineer Regiment, the RE Wing produced a 'concept demonstrator' that showed considerable promise. In early 1986 a requirement for 12, subsequently 17, vehicles was issued, with 12 to be ready for troop trials in BAOR before the autumn manoeuvres of 1987, two for the British Army Training Unit at Suffield (BATUS) in Canada, two for the RE Wing at Bovington, and a base model for Vickers Defence Systems. However, no civilian contractor was willing to meet the strict deadline and there was no spare capacity in REME base workshops to undertake the conversions. The Sappers had to rely on their own resources.



The first Chieftain AVREs were simple conversions of redundant gun tanks undertaken by the 21 Engineer Base Workshop of 40 Army Engineer Support Group at Willich in West Germany. Seventeen of these vehicles were built and they became known as 'Willich AVREs'. This example shows the hull-mounted steel frame in two sections that was originally called the 'roof rack' and subsequently the 'hamper'.

The task was given to 40 Army Engineer Support Group and 21 Engineer Base Workshop at Willich in West Germany. With commendable energy and alacrity, the first Chieftain AVRE was delivered on 9 August for user trials with 32 Armoured Engineer Regiment. These trials suggested a number of modifications, which were incorporated in the next two AVREs during conversion before they were delivered on 9 October. After further user trials and another 40 suggested modifications, the design was sealed and production of the remaining 14 vehicles was undertaken. The first three models were then modified to the production standard so that all 17 were completed on schedule at a unit cost of some £80,000 whereas the initial industry estimate was in the region of £380,000 per vehicle. These vehicles became known as the 'Willich AVREs' and they proved to be highly successful, though service use did indicate some shortcomings. In late 1989 Vickers Defence Systems was awarded a contract for the design, development and conversion of a further 48 Chieftain gun tanks to Chieftain AVRE or CHAVRE. The contract was for two prototype vehicles and 46 production vehicles of enhanced capability in two batches. The first two prototypes were completed in 1991 with production running until 1994. Meanwhile, the Willich AVREs were deployed to the Gulf for Operation Granby and the liberation of Kuwait – see Plate F2.

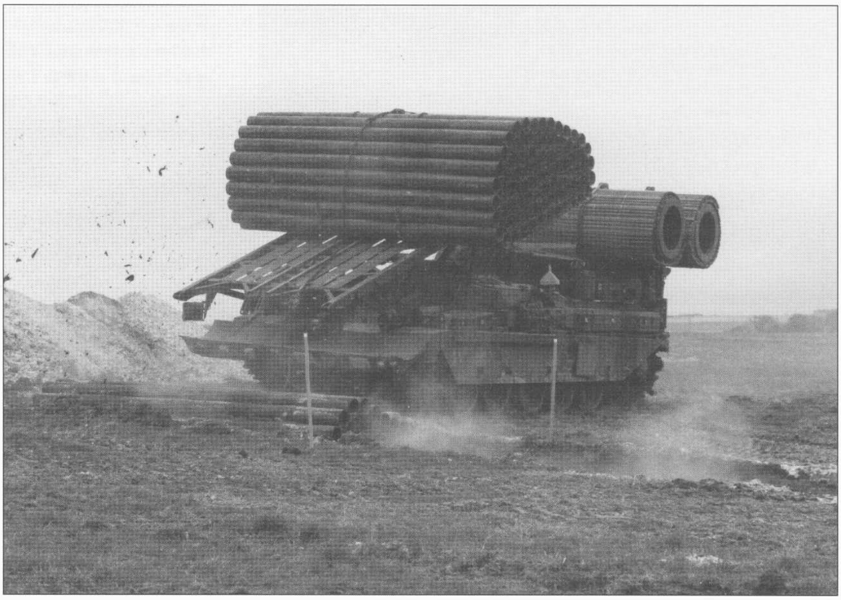
The definitive CHAVRE was designed to maintain the mobility of the battlegroup by breaching minefields and overcoming obstacles such as anti-tank ditches and in creating obstacles to impede the advance of the enemy by acting as a prime mover for minelaying equipments. To this end, a load-carrying platform is fitted over the top of the vehicle chassis. This platform or 'hamper' extends over the full length of the



The definitive model of Chieftain AVRE or CHAVRE was designed and developed by Vickers Defence Systems in conjunction with the Royal Engineers. The CHAVRE is provided with two load platforms capable of deploying Maxi-Pipe fascines and Class 60 Trackway from both the front and rear. These are shown here in the raised position to allow engine maintenance and the crew easier egress from the vehicle. The Ferrari hydraulic on-board crane is visible behind the hamper with the two fascines.

vehicle and is split into two sections, each of which can be operated independently. The hamper can carry up to 14.5 tons of equipment, be it fascines, trackway, bridging or general stores such as mines. Each section of the hamper can be tilted by hydraulic rams using remote control from under armour. This allows the fascines or trackway to be launched to both front and rear with the loads secured by chains that are cut by explosive bolts. The loading and positioning of stores onto the hamper is achieved using the vehicle's integral crane or winch.

The CHAVRE is fitted with a Ferrari hydraulic crane to lift loads on to and off the hamper. It has a maximum load capacity of 2.9 tonnes with a reach of 5m and can also be used in vehicle maintenance to remove assemblies such as engine decks or gearbox. A Rotzler capstan winch is fitted to the rear of the vehicle to assist in handling stores and recovering fascines that have been launched. The winch has a maximum capacity of 10 tonnes. For mine clearance and earthmoving, the CHAVRE has fittings to accept the Pearson Engineering mineplough or universal dozer blade, each of which can be fitted by the vehicle's own crane. The CHAVRE can also tow two Giant Viper trailers to project explosive lines over minefields and fire them from under armour. The CHAVRE is to be replaced later in this decade by a vehicle based on the Challenger 2 chassis and known as Trojan.

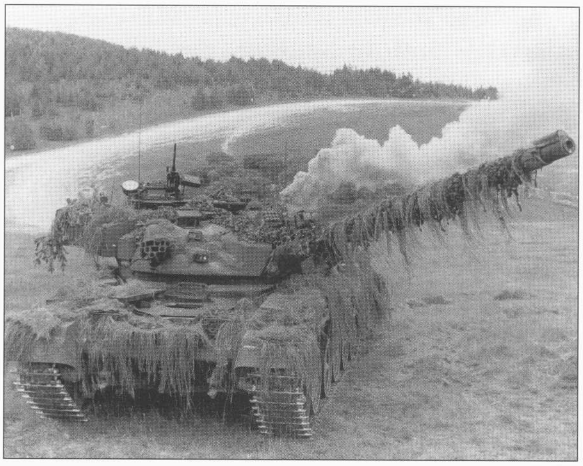


A Maxi-Pipe fascine drops into an anti-tank ditch from the front hamper of a CHAVRE during a training exercise. The fascine is released remotely from under armour by the firing of explosive bolts attached to the securing chains. A normal CHAVRE load is two Maxi-Pipe fascines and two rolls of Class 60 Trackway but any combination can be carried such as three fascines or up to nine rolls of trackway. The trackway is used as approach matting to bridging sites or crossing points to prevent large numbers of AFVs from churning up the ground and making it impassable to following vehicles.

COLOUR PLATE COMMENTARY

A1: CHIEFTAIN MARK 2(Y) C, 5TH ROYAL INNISKILLING DRAGOON GUARDS BATTLEGROUP, EXERCISE MEDICINE MAN, BATUS, CANADA, JULY 1978

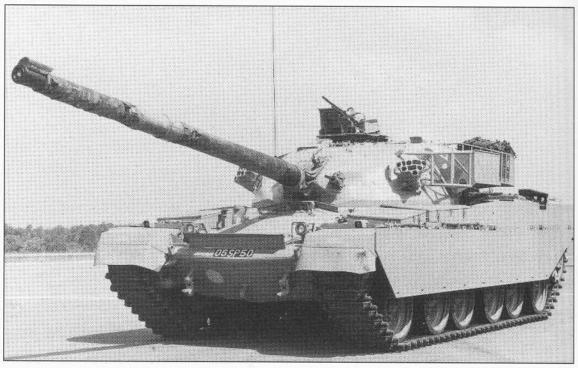
The British Army training facility at Suffield in Alberta, Canada, stretches over 2,500 square kilometres of rolling prairie. The vast open spaces allow the firing of virtually all the weapons systems within the all-arms battlegroup. The battlegroups of each deployment codenamed Medicine Man are either mechanised infantry or armour dominated and this particular Chieftain is employed by the 5th Royal Inniskilling Dragoon Guards Battlegroup. The tank is finished in the characteristic BATUS camouflage scheme of green and sand yellow stripes. To front and rear it bears the registration number 05EB71 in white letters and numerals on a black rectangular background with that on the rear displayed on the right-hand trackguard as viewed and that on the front lower hull offset to the right as viewed. The zap code Tango Three Four Bravo is painted on the side plates. The white stripe on the forward face of the turret is an indicator to the tank commander of his safe arcs of fire. On the left front trackguard as viewed is stencilled 2ND ARMD SQN (signifying Second Armoured Squadron) and on the right-hand one 1/78 which is a date stamp to indicate when the vehicle was last overhauled. The red flag is flown when the tank's weapons are loaded with live ammunition.



Smoke billows from a Chieftain MBT that has been 'knocked-out' by an opposing tank during a tactical training exercise. This well-camouflaged Chieftain is equipped with a laser projector mounted in the muzzle of the main armament. During an 'engagement', the crew must undertake the complete loading and firing sequence for the system to function properly. The laser then projects a stream of pulses towards the target, which, by means of its turret-mounted detectors, receives the signal, processes the relevant data, such as range and projectile type, and confirms a successful 'kill' by igniting a smoke pyrotechnic to indicate that the target has been disabled. This late mark Chieftain is fitted with supplementary Stillbrew passive armour around the turret front and driver's position to give increased protection over the frontal aspect.

A2: CHIEFTAIN MARK 5/3 C, 4TH TROOP CAT SQUADRON, THE ROYAL SCOTS DRAGOON GUARDS, CANADIAN ARMY TROPHY 1983, BERGEN-HOHNE, WEST GERMANY, JUNE 1983

The Canadian Army Trophy was an annual, then biannual, tank gunnery contest within the NATO alliance of those countries with armour units in West Germany. For many years it was a highly prestigious competition with great kudos accruing to the winning team and the type of tank they crewed. The Chieftain only won the trophy once in the hands of the 16th/5th The Queen's Royal Lancers in 1970. In CAT83, the British Army was represented by The Royal Scots



Following its original purchases of Chieftain, the Imperial Iranian Army ordered 1,225 of an improved model originally called Shir Iran or Lion of Persia. Designated FV4030 by the British, the Shir featured a 1,200bhp Rolls-Royce power pack and a revolutionary new form of protection called Chobham armour that had recently been developed at MVEE. Pending full development of this MBT, an interim model known as FV4030/2 or Shir 1 was produced. This was based on the Chieftain but with a new rear hull and suspension layout to accommodate the new Rolls-Royce power pack. Three prototypes were completed by January 1977 and series production of 125 Shir 1s began at ROF Leeds with the first deliveries scheduled in 1980. However, following the fall of the Shah of Iran, the complete order was cancelled in February 1979. Fortuitously, in November of the same year, the Royal Hashemite Kingdom of Jordan ordered 278 of the tank at a unit cost of £1 million under the designation Khalid – a fabled Bedu warrior. Besides the new power pack, the Khalid featured the Improved Fire Control System integrated with the commander's combined day and passive night sight, which provided the commander with a 24-hour day/night observation and firing capability. The FV4030/3 or Shir 2 developed for Iran subsequently became the Challenger 1 MBT for the British Army. When the latter was replaced by Challenger 2, 288 redundant Challenger 1s were procured by the Jordanian Army under the designation Al Hussein. The Jordanians also acquired 90 Chieftains from Iraq following the Iran–Iraq War.

Dragoon Guards, hence the Lion Rampant flag flying above this Chieftain Mark 5/3 C. This model featured the newly installed Improved Fire Control System, each costing £90,000, and great hopes were held for CAT83 as this regiment has traditionally had a high reputation for tank gunnery within the Royal Armoured Corps. The tank carries the registration number 00FD66 to front and rear; again offset to the right on the lower front hull; offset to the left as viewed there is a subdued weight classification of a grey 56 on a solid black circle. The vehicle callsign Four Bravo is displayed on the side plates and centrally on the turret rear NBC pack with 4B painted in grey on a black square. Note the difference between the L11A5 120mm Tank Gun with the L11A2 and A3 type as shown on Plate A1 with the mirror of the Muzzle Reference System mounted above the end of the barrel.

B: CHIEFTAIN 2(Y)/L, HEADQUARTERS SQUADRON, THE QUEEN'S ROYAL IRISH HUSSARS, PADERBORN, BAOR, 1978

This three-view colour plate shows the typical temperate zone British Army camouflage scheme of the Chieftain MBT throughout its career of dark green and disruptive black stripes. The red diamond on the searchlight housing denotes Headquarters Squadron within the armoured regiment. The vehicle callsign Zero Delta is carried on a black metal plate attached to the NBC pack and signifies the commanding officer's tank. This is reinforced by the tank's name of KOJAK after the bald hero of the 1970s New York detective TV series and a reference to the lack of hair of the commanding officer of the Irish Hussars – Lt Col. Richard S. Webster. The tank displays the registration number 02EB86 to front and rear as well as the Union Flag. On the lower rear hull plate is a night convoy distance marker of alternating black and white stripes. The Chieftain is shown on a firing range to calibrate the coaxial machine gun and ranging gun so the green flag indicates that none of the weapons is loaded with live ammunition.

C: CHIEFTAIN MARK 10 C, ARMOURED SQUADRON, BERLIN BRIGADE, 1980s

Throughout the Cold War, the British Army of the Rhine stationed one reinforced infantry brigade in the former German capital of Berlin, which was occupied by the four World War II allies of Britain, France, the Soviet Union and the USA. It was common practice to attach a tank squadron to the Berlin Brigade to provide armour support to the infantry but as Berlin was deep inside the Soviet zone the brigade was only ever a hostage to fortune and in times of hostilities would have been overwhelmed in short order. During the early 1980s, Major Clendon Daukes of the 4th/7th Royal Dragoon Guards devised a radically new camouflage scheme for fighting in an urban environment. The chequerboard pattern of white, grey and brown proved more difficult to detect amongst buildings particularly from the air and it was adopted for all AFVs stationed in Berlin with the British Army. This Chieftain Mark 10 C is shown during FIBUA (Fighting In Built Up Areas) training in a mock town during the depths of winter.

D: FV4201 CHIEFTAIN MARK 5

The Chieftain Mark 5 was the definitive production model and this colour plate shows the complexity of a modern MBT. The vehicle is finished in the standard British Army camouflage scheme of green and black stripes.

DATA:

Crew: 4 (commander, gunner, loader, driver)

Weight: 55,000kg combat loaded; 53,500kg unladen

Length: 10.795m gun forwards; 9.87m gun rearwards; hull length 7.518m

Width: 3.657m including searchlight; 3.504m over side plates

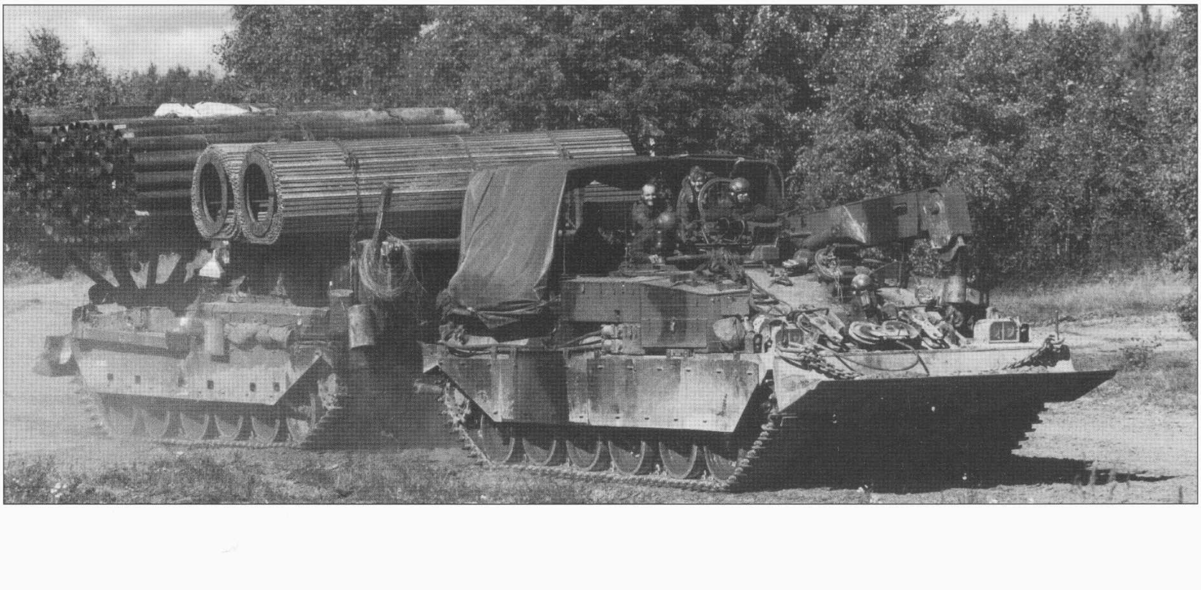
Height: 2.895m overall; 2.82m to top of cupola

Ground clearance: 0.508m

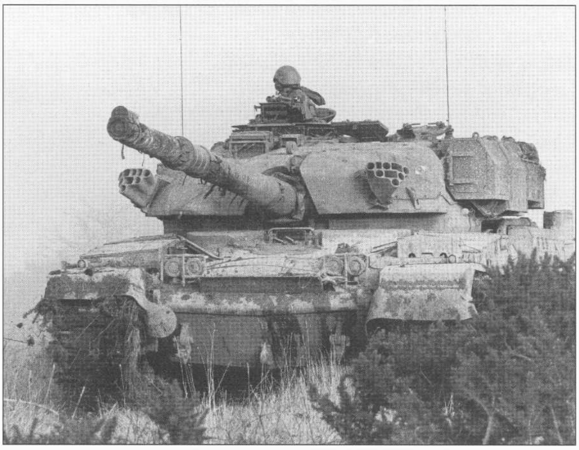
Track width: 0.610m

Length of track on ground: 4.8m

With its Atlas crane deployed to the front, a Chieftain Mark 7 ARRV of the 2nd Royal Tank Regiment Battlegroup tows a disabled Chieftain CHAVRE during Exercise Uhlan Eagle '96 in Poland. Because of their front-mounted dozer blades or mineploughs, CHAVREs and CHAVLBs have to be towed backwards during recovery operations. The REME crew have erected a tarpaulin over the engine decks to make a comfortable sleeping quarter at night with the benefit of residual engine heat to keep them warm, a common ploy during field exercises.



Stillbrew passive armour was developed during the 1970s at MVEE Chertsey, Stillbrew being an amalgamation from the names of the two inventors of the new armour. Although there was no formal British Army requirement for any supplementary armour for Chieftain MBT, trials showed that it gave a substantial increase in armour protection at a modest cost with little degradation in automotive performance. In particular, it gave considerably higher protection against hollow-charge weapons, such as the RPGs and Saggers that had caused significant Israeli tank losses during the October War of 1973. After highly successful firing and mobility trials during 1984 and 1985, Royal Ordnance Leeds began the manufacture of the appliqué armour package. It is fitted over the frontal aspect of the turret and around the driver's position to give additional protection to the turret ring. From 1986 Chieftains were fitted with Stillbrew armour in 23 REME Base Workshops at Wetter, West Germany, during base overhaul. The addition of Stillbrew and other survivability aids together with TOGS were the final major modifications to be made to the Chieftain MBT and produced the final mark of the tank – see plate G. A total of 324 Chieftains were fitted with TOGS following the first delivery of the system in December 1983. The TOGS installation can be seen on the left-hand side of the turret of this Chieftain Mark 11 C of the 4th Royal Tank Regiment as it reverses out of a fire position during a field training exercise.



Nominal ground pressure: 88.29KN/m2
Maximum speed: 48km/h road; approx 32km/h cross-country
Maximum gradient: 60%
Vertical obstacle: 0.914m
Trench crossing: 3.149m
Fording: 1.066m
Maximum range: 500km road; 200–300km cross-country
Fuel capacity: 950 litres diesel
Engine: Leyland L60, liquid cooled, compression ignition, 26.11 litres capacity
Model: Mark 7A
Output: 720bhp at 2,100rpm
Auxiliary engine: Coventry Climax H30 Mark 10A 3-cylinder opposed piston two-stroke of 375bhp at 3,000rpm
Transmission: TN12 Merritt-Wilson with six forward and two reverse gears
Steering: Merritt regenerative incorporated in TN12
Suspension: Horstmann with 12 pairs of twin wheels in six bogies
Tracks: Dry pin, rubber padded with 96 links per track when new weighing 4,719kg
Electrical system: 28.5V dc (nominal); two dc generators, 150A on main engine and 350A on auxiliary engine (GUE) with parallel operation and load sharing
Main armament: OBL 120mm L11A3 rifled tank gun with fume extractor and thermal sleeve
Secondary armament: L8A1 7.62mm coaxial machine gun and L37A1 7.62mm machine gun on commander's cupola plus .50-cal. ranging gun
Local protection: Two six-barrel smoke grenade dischargers
Ammunition: 64 rounds of 120mm, 6,800 rounds of 7.62mm and 600 of .50-cal.
Gun control equipment: FVGCE No. 7 Mark 4
Night-fighting equipment: Light Projector No.2 Mark 3 providing white and infrared illumination combined with IR sights for commander, gunner and driver
Crew protection: No.6 Mark 2 ventilation and NBC filter system

E: CHIEFTAIN MARK 5/2K, 38TH ARMOURED BRIGADE, KUWAITI ARMY, SAUDI ARABIA, AUGUST 1990

On 12 June 1961, Kuwait declared its independence but within weeks, the country was threatened with invasion from neighbouring Iraq. The British promptly despatched the Centurions of C Squadron 3rd Carabiniers from Aden to patrol the disputed border and the crisis was averted. In gratitude, the Kuwaiti Army purchased 50 Centurion tanks and subsequently 165 Chieftains designated Mark 5/2K. Following the Iraqi invasion of 2 August 1990, approximately 50 Chieftains of the 38th Armoured Brigade withdrew towards Saudi Arabia and 18 made it across the border. These were then refurbished by the British Army and, together with newly procured M84 MBTs from Yugoslavia (a version of the Soviet T-72 made under licence), equipped the Al Shahid or Martyrs Brigade during the liberation of Kuwait in February 1991. Flying the Kuwaiti flag from its radio antennae, this Chieftain Mark 5/2K is depicted crossing the border into Saudi Arabia. Its only markings are the registration number on the rear left trackguard as viewed: 8466 and the inscription "The Army" in Arabic script. This is repeated on the front left trackguard as viewed and on the opposite trackguard is the formation sign of a small yellow over blue rectangle divided diagonally from bottom left to top right A companion vehicle displayed a callsign board as shown in the scrap view that denotes Tank B 13. All Kuwaiti Chieftains carried the standard British Army night convoy distance marker of alternating black and white stripes on the lower rear hull plate as shown on plate B.

F1: CHIEFTAIN MARK 7 ARRV, FORWARD REPAIR GROUP, 4TH ARMOURED BRIGADE, OPERATION GRANBY, FEBRUARY 1991

The deployment of hundreds of AFVs into the Saudi Arabian desert demanded massive REME support to maintain and modify them for the coming offensive. With no base workshops, almost all work had to be undertaken in the open under the most difficult conditions. Besides the dedicated Chieftain ARRVs in each armoured squadron, further ARRVs, including the first production models of the Challenger ARRV, were deployed in support of the armoured regiments in Forward Repair Groups or FRGs. This Chieftain Mark 7 ARRV is named ARRVY SMITH after the famous show jumper Harvey Smith and the name is carried on both sides of the vehicle forward of the black chevron mutual recognition device. On the other side of the vehicle above and behind the name ARRVY SMITH is the unit zap code 1/6/FRG denoted this vehicle was deployed in support of 4th Armoured Brigade. The vehicle registration number 06FF84 is carried on the front right and right rear trackguards as viewed and below the front one is an inscription on the dozer blade as shown in the scrap view. This ARRV carries a cradle for a spare powerpack for a Challenger MBT over its engine decks for replacement in the field by means of the hydraulic crane.

F2: CHIEFTAIN AVRE, 23 ENGINEER REGIMENT, OPERATION GRANBY, FEBRUARY 1991

The Chieftain AVREs deployed on Operation Granby were of the Willich type. The extensive fortified lines created by the Iraqis along the Kuwaiti border with Saudi Arabia were initially believed to be a formidable obstacle requiring considerable engineer assets to breach them. Each of the battlegroups within the 1ST (UK) Armoured Division was given its own integral Royal Engineer close support troop. This commonly comprised two AVREs, two AVLBs, two Combat Engineer Tractors, two field sections in FV432s and up to three CVR(T) Spartans for command and reconnaissance roles. This AVRE is being prepared for combat prior to the land offensive. Beside the Maxi-Pipe fascine, it has been fitted with a full-width mineplough and chain armour at the front to detonate RPGs fired at the drivers compartment. Further protection to the crew compartment has been provided along the sides in the form of Warrior Chobham armour panels and these bear the vehicle callsign of Four Three Alpha and the vehicle nickname of THE FLYING CODPIECE. The vehicle registration number 05EB44 is carried on the rear right trackguard as viewed. This vehicle is yet to be fitted with MIMIC (Magnetic Influence Mine Induction Coil) above the mineplough and the Giant Viper trailer. A typical AVRE load during Operation Desert Sabre was two Maxi-Pipe fascines and one roll of Class-60 Trackway. Fifteen out of the fleet of 18 CHAVREs were deployed on Operation Granby with six each in 21 and 23 Engineer Regiments and three in War Maintenance Reserve.

G: CHIEFTAIN MARK 11 C, B SQUADRON 1ST ROYAL TANK REGIMENT, CASTLEMARTIN GUNNERY RANGES, SOUTH WALES, MAY 1995

This Chieftain Mark 11 C is depicted approaching the firing line on the tank gunnery ranges at Castlemartin in South Wales. On 15 May 1995, 03EB91 fired the last main armament round by a Chieftain MBT in British Army service. The tank belonged to B Squadron of the 1st Royal Tank Regiment and the yellow square squadron symbol is displayed on the right-hand turret stowage bin; centrally on the NBC pack and on the rear barbette of the TOGS housing. Inside each of the yellow squares is the vehicle callsign Three Two which denotes the troop corporals tank of Three Troop. The tank can also be identified by the three rings on the fume extractor for Three Troop and the two rings around the muzzle for the third tank within the troop; the troop commander's tank Three Zero having no rings around the muzzle. The vehicle registration number 03EB91 is carried centrally on the lower hull front, below which is the bridging classification plate of a black 70 on a solid grey circle, and on the rear right-hand trackguard as viewed. On the lower rear hull plate is a white square with the vehicle's callsign superimposed in black within a black square. This is situated below a subdued white light so that the vehicle can be readily identified by troops on the ground during blackout conditions such as fuel and ammunition replenishment. On the side of the Clansman Aerial Tuning Unit box is a lurid unofficial troop insignia. Other unusual but official markings are the Chinese eyes on each side of the turret face. This was an old tradition of the 4th Royal Tank Regiment dating back to the 4th Battalion in the Great War. On the amalgamation of the 1st and 4th Royal Tank Regiments in 1992, the tradition was passed on to the new 1RTR and all its tanks and vehicles carry them. Similarly, 4RTR used to name its vehicles with names beginning with the fourth letter of the alphabet and two squadrons within 1RTR continue the tradition. This Chieftain was called DEFIANT painted in small grey capital letters on the second front stowage bins above the trackguards.

With the setting sun casting long shadows, a Chieftain Mark 11 C of the 4th Royal Tank Regiment returns to its night leaguer at the conclusion of the final exercise conducted by the Chieftain MBT with the British Army on Salisbury Plain in June 1995. During the 1980s, serious consideration was given to instituting CHIRP or the Chieftain Improvement Retrofit Programme. This was intended to enhance firepower and survivability by fitting a new High Pressure Gun and the Improved Computerised Sighting System along with further improvements to the commander's cupola as well as stowage for the Depleted Uranium Round. Improved survivability was to be provided by new armour packages including Stillbrew and Trackmark and by the replacement of the No. 6 NBC pack by the No. 11 Mark 1 and Control Panel No. 15 Mark 1. However, only Stillbrew and the new NBC pack were ever fitted in quantity and, interestingly, CHIRP did not address any automotive improvements to the Chieftain. To the end, Chieftain's reputation was sullied by doubts over the reliability and serviceability of the L60 engine. If the Chieftain had been fitted from the outset with a simple, reliable diesel engine with an assured output of 750bhp, such as the Continental AVDS-1790 that powered thousands of contemporary MBTs, then the Chieftain would have been a world-beater. In the event, the sorry saga of the L60 led to a complete loss of faith in British tank designs and neither of Chieftain's successors has been purchased in quantity by foreign armies.

INDEX

ammunition **5**
  bagged charge **4**, 5–6
  stowage 5–6, **17–19**, 22, 23
Armament Research and Development Establishment (ARDE), Fort Halstead 4–5, 7
armour 8, **F2**
  Chobham **39**, 40, **44**, **F2**
  Stillbrew 24, **44**, 46

Berlin, operations in 45, **C**
boiling vessels (BVs) **20**
Bosnia, operations in **37**, **40**, **41**
bridgelayers 33, **37**, **38**, 39–41, **40**, **41**

camouflage **44**, 45, **B**, **D**
  BATUS 44, **A1**
  netting **21**
  urban 45, **C**
Canada, training in **16**, 44
Canadian Army Trophy (CAT) 44–5
Chieftain Improvement Retrofit Programme (CHIRP) 47
Chieftain MBT **3**
  design and development 4–15
  detailed plan **D**
  driving 7, 16, **20**, 33
  interior **17–20**
  reliability 10, 11, 14, 15, 16, 47
  specifications 45–6
  technical description 15–18
Chieftain MBT: models
  AEVs **24**
  CHAVLBs 40–1
  CHAVREs 33, **33**, **39**, 41–3, **43**, **45**
  FV4202 24
  FV4203 AVRE 24–33
  FV4204 ARV 33, **36**, 37–9
  FV4205 AVLB 33, 39–41
  Khalids **44**
  Mark 1 **11**, 13, 19–20
  Mark 2 **12**, 13, **13**, **14**, **16**
  Mark 2(Y) C 44, **A1**
  Mark 2(Y)/2 **22**
  Mark 2(Y)/L 45, **B**
  Mark 3 14, 20–2, **23**, **34**
  Mark 4 22
  Mark 5 14–18, **17–20**, 22–3, **36**, 45–6, **D**
  Mark 5 AVLB **37**, **38**, 40, **40**, **41**
  Mark 5/2K 46, **E**
  Mark 5/3 C 44–5, **A2**
  Mark 6 23
  Mark 6 AVLB 38, 40
  Mark 7 24
  Mark 7 ARRV **36**, 39, **45**, 46–7, **F1**
  Mark 8 24
  Mark 9 24
  Mark 10 24, 45, **C**
  Mark 11 24, **46**, 47, **47**, **G**
  Mark 15 24
  pre-production models **9**
  prototypes **8**, 19
  Qayd al Ardhs 18
  Shirs (FV4030) 18, **44**
  Willich AVREs 42, **42**, 47, **F2**
Close Support Bridging (CSB) system 40–1
Combustible Cartridge Cases **4**, 12
cranes 36, 39, 43, **43**, **45**, **F1**
cupolas **11**, **12**, 16, 20

Dark Morn programme 34
Daukes, Maj. Clendon 45
dozer blades **24**, 33, **34**, **36**, **F1**, **F2**

engines
  GUE 16
  L60, development 8–9, 13, 18, 20, 22, 33–5
  L60, reliability 10, 11, 14, 15, 16, 47
  other 7, 18
  see also Totem Pole
exhaust system 22

Fighting Vehicles Research and Development Establishment (FVRDE), Chertsey 5, 7, 10, 11, 33
  see also Military Vehicles and Engineering Establishment
fire control systems 11, 17–18, **19**, 23, 44, 45
  see also Totem Pole
FV434 Fitters Vehicle 39

gearboxes 9, 10, 11, 15, 18, 23
Gulf War (1991) 15, **39**, 40, 46–7, **F1**, **F2**
guns, ranging 11, 17, **21**
guns, tank
  aiming 17–18
  L7 4
  L11 5, 17–18, **21**, 44–5, **A1**, **A2**, **D**
  liquid propellant 5
  loading 12, 17
  T-104 4

hatches **11**, **12**
headlights 19, 21, **21**, **D**
heating system 12
High Noon programme 34
hull design 7–8, 19

Iran, use of Chieftains 6, 18, 21, 22, 23, 44
  ARVs 39
Iraq, operations in 39
Iraq, use of Chieftains 44
Israel, use of Chieftains 13–14, 22

Jordan, use of Chieftains 39, 44

Kuwait, use of Chieftains 18, 46, **E**

Leyland Motors 7, 9, 10, 33
load platforms 42–3, **43**
Lockheed Precision Products 38, 39

machine guns **13**, 17, 21, 22, 36, **D**
Magnetic Influence Mine Induction Coils (MIMIC) **39**, 40
Military Vehicles and Engineering Establishment (MVEE) 39
  see also Fighting Vehicles Research and Development Establishment
mine detection and clearance 39, 40, 42
mineploughs **33**, **38**, **39**, 40, **F2**

night sight 16, 17, 44
Nuclear, Bacteriological, Chemical (NBC) packs 22, 24, 47

Oman, use of Chieftains 18, 24
Operation Granby (1991) **39**, 46–7, **F1**, **F2**
Operation Telic (2003) 39

periscopes 16, 17, 21, **D**
pipe fascines **33**, 42, **43**, **F2**
power packs 39, 44
Project Prodigal 6

radios 17, **19**, 23, 37
range 9, 15, 46
Royal Ordnance Leeds
  and ARVs 38
  and AVLBs 39, 40
  production 11, 13, 19, 21, 22, 23, 33
  and prototypes 9, 10
  Stillbrew armour 46

Simfire (Simfics) 23, 44
smoke grenade dischargers **13**, 36
specifications, Mark 5 45–6
speed 9, 15, 46
Starr, Maj. Bert 11
Sundance programme 15, 34
suspension 7, 8, 10, 18, 23

Tal, Maj. Gen. Israel 'Talik' 13, 14
Tank Laser Sight (TLS) 17–18, 20, 21, 22, 23
tanks
  Centurions 3–4, 5, 6, 12, 37, 41–2
  Challengers 15, 39, 44
  Conquerors 6–7
  French 6, 13
  Leopard 1s 10
  Merkavas 14
  Panzers 3, 4
  Soviet 4
  T-95/96 7
  Universal 3–4
  see also Chieftain MBT

Thermal Observation and Gunnery System (TOGS) 24, **46**
Totem Pole 14, 20, 21, 22, 24, 36–7
tracks 12, 18
trackway **43**, 44
trailers, Giant Viper 42, 43
transmission 9
turrets 7–8, 16–17, 19, 20

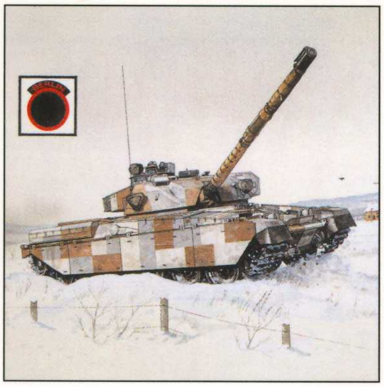
Vickers-Armstrong
  and ARVs 38–9
  production 11, 13, 19, 23, 33
  and prototypes 9, 10
Vickers Defence Systems 38, 40, 42, 43

Webster, Lt Col. Richard S. 45
winches 33, **36**, 37–8, 43

The design, development, operation and history of the machinery of warfare through the ages.

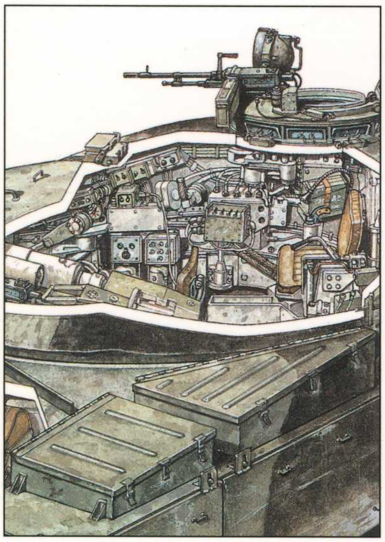
Chieftain Main Battle Tank 1965–2003

The concept of the Main Battle Tank emerged from the Centurion Universal tank that was developed at the end of World War II. Development of its successor began as early as 1951. The Chieftain incorporated significant innovations including a reclining driver position and two-piece ammunition for greater survivability. The tank entered service in 1967 and was the heaviest armed and armoured MBT within the NATO alliance. The Chieftain saw combat during the Iran–Iraq War, with the Kuwaitis during the 1990 Iraqi invasion and with the British Army during the Gulf War of 1990–91 as special purpose variants. This book explores the design, development and operation of one of the most influential vehicles used in modern warfare.

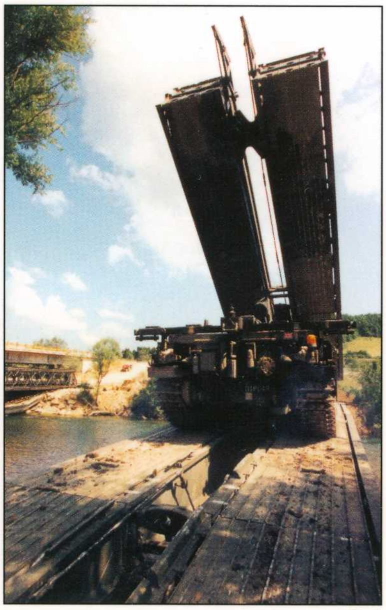


Full colour artwork

Unrivalled detail



Cutaway artwork



Photographs

OSPREY
PUBLISHING

www.ospreypublishing.com

ISBN 1-84176-719-0

9 781841 767192